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(54) **Composite particles, process for producing the same, and pigment, paint and resin composition using the same**

(57) Composite particles which have an average particle diameter of from 0.001 to 10.0 μm , comprising:

- (i) white inorganic particles as core particles;
- (ii) a gluing agent coating layer provided on the surface of said white inorganic particles; and
- (iii) an organic pigment coat provided on said gluing agent coating layer in an amount of from

1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.

The composite particles may be used in a paint or a rubber or resin composition.

EP 1 184 426 A2

Description

[0001] The present invention relates to composite particles, a process for producing the composite particles, and a pigment, paint and resin composition using the composite particles. More particularly, the present invention relates to composite particles which are substantially free from desorption of an organic pigment from the surface thereof and contain no harmful element, a process for producing the composite particles, and a pigment, paint and resin composition using such composite particles.

[0002] As well known in the arts, inorganic pigments and organic pigments have been used as colorants for resins, paints, printing inks or the like according to applications thereof. Also, it is known that the inorganic pigments are usually excellent in light resistance, but are deteriorated in tinting strength, thereby failing to show a clear hue. Although some inorganic pigments exhibit a clear hue, many of such pigments contain as essential component, harmful metals such as lead, mercury, cadmium, chromium or the like. Therefore, it has been strongly required to replace these conventional inorganic pigments with alternate materials capable of showing a clear hue, from the standpoints of hygiene, safety and environmental protection.

[0003] On the other hand, it is known that the organic pigments usually show a clear hue, but are deteriorated in hiding power and light resistance.

[0004] Hitherto, in order to obtain pigments exhibiting excellent properties required for colorants, it has been attempted to combine the inorganic pigments with the organic pigments. For example, there have been proposed the method of co-precipitating chrome yellow and phthalocyanine blue together, the method of adhering an organic pigment to the surface of inorganic pigment particles (Japanese Patent Application Laid-Open (KOKAI) Nos. 4-132770(1992) and 11-181329(1999), etc.) or the like.

[0005] At present, it has been strongly required to provide composite particles which are substantially free from desorption of organic pigment from the surface thereof, and contain no harmful elements. However, such composite particles have not been obtained.

[0006] That is, in the above method in which chrome yellow and phthalocyanine blue are co-precipitated together, the chrome yellow used therein shows a toxicity, and the obtained pigment shows an insufficient storage stability in a paint produced therefrom due to the co-precipitation production method thereof. Further, when such paint is formed into a coating film, undesired floating tends to be caused thereon.

[0007] Also, in the method described in Japanese Patent Application Laid-Open (KOKAI) No. 4-132770(1992), since the organic pigment is simply precipitated in the presence of the inorganic pigment, the adhesion strength of the organic pigment onto the inorganic pigment is insufficient.

[0008] Further, in the method described in Japanese Patent Application Laid-Open (KOKAI) No. 11-181329(1999), organopolysiloxane is dissolved in cyclic silicone, and organic pigment particles are added to the resultant solution so as to produce fine particles of the organic pigment. The mixture is impregnated into a high-oil absorptive inorganic pigment. Then, the cyclic silicone is evaporated from the obtained pigment. Therefore, the adhesion strength of the organic pigment onto the inorganic pigment is also insufficient.

[0009] Meanwhile, in Japanese Patent Application Laid-Open (KOKAI) No. 11-323174(1999), there are also described black iron-based composite particles comprising as core particles black iron oxide particles or black iron oxide hydroxide particles, a coating layer formed on surface of the core particle which comprises organosilane compounds obtainable from alkoxysilanes, and a carbon black coat formed onto the surface of the coating layer. However, the invention of this KOKAI relates to fixing carbon black onto the black inorganic particles as core particles, and the technique described therein, therefore, is quite different from techniques for obtaining an organic pigment having an excellent hue.

[0010] As a result of the present inventors' earnest studies, it has been found that by forming a gluing agent coating layer on surface of a white inorganic particle and forming an organic pigment coat on the gluing agent coating layer in an amount of 1 to 500 parts by weight based on 100 parts by weight of the white inorganic particles, the obtained composite particles having an average particle size of 0.001 to 10.0 μm are substantially free from desorption of organic pigment from the surface thereof, and are usable as a harmless pigment. The present invention has been attained on the basis of the finding.

[0011] An object of the present invention is to provide composite particles which are substantially free from desorption of organic pigment from the surface thereof, and contain no harmful elements.

[0012] Another object of the present invention is to provide a harmless pigment which is substantially free from desorption of organic pigment from the surface thereof.

[0013] A further object of the present invention is to provide a paint exhibiting excellent stability and dispersibility.

[0014] A still further object of the present invention is to provide a resin composition having an excellent pigment dispersibility therein.

[0015] To accomplish the aims, in a first aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 10.0 μm , comprising:

white inorganic particles as core particles;
 a gluing agent coating layer formed on surface of said white inorganic particle; and
 an organic pigment coat formed onto said gluing agent coating layer in an amount of from 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.

[0016] In a second aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 10.0 μm , comprising:

white inorganic particles as core particles, each having on at least a part of the surface thereof, a coating layer comprising at least one compound selected from the group consisting of hydroxides of aluminum, oxides of aluminum, hydroxides of silicon and oxides of silicon;
 a gluing agent coating layer formed on surface of said white inorganic particle; and
 an organic pigment coat formed onto said gluing agent coating layer in an amount of from 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.

[0017] In a third aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 10.0 μm , comprising:

white inorganic particles as core particles;
 a gluing agent coating layer formed on surface of said white inorganic particle, comprising at least one selected from the group consisting of a silane-based coupling agent, a titanate-based coupling agent, an aluminate-based coupling agent, a zirconate-based coupling agent, an oligomer compound, a polymer compound and an organo-silicon compound selected from the group consisting of:

- (1) organosilane compounds obtainable from alkoxysilane compounds,
- (2) polysiloxanes or modified polysiloxanes, and
- (3) fluoroalkyl organosilane compounds obtainable from fluoroalkylsilane compounds; and

an organic pigment coat formed on said coating layer in an amount of from 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.

[0018] In a fourth aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 10.0 μm , comprising:

white inorganic particles as core particles, each having on at least a part of the surface thereof, a coating layer comprising at least one compound selected from the group consisting of hydroxides of aluminum, oxides of aluminum, hydroxides of silicon and oxides of silicon;
 a gluing agent coating layer formed on surface of said white inorganic particle, comprising at least one selected from the group consisting of a silane-based coupling agent, a titanate-based coupling agent, an aluminate-based coupling agent, a zirconate-based coupling agent, an oligomer compound, a polymer compound and an organo-silicon compound selected from the group consisting of:

- (1) organosilane compounds obtainable from alkoxysilane compounds,
- (2) polysiloxanes or modified polysiloxanes, and
- (3) fluoroalkyl organosilane compounds obtainable from fluoroalkylsilane compounds; and

an organic pigment coat formed on said coating layer in an amount of from 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.

[0019] In a fifth aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 10.0 μm , comprising:

white inorganic particles as core particles, each having on at least a part of the surface thereof, a coating layer comprising at least one compound selected from the group consisting of hydroxides of aluminum, oxides of aluminum, hydroxides of silicon and oxides of silicon;
 a coating layer formed on surface of said white inorganic particle, comprising at least one organosilicon compound selected from the group consisting of:

- (1) organosilane compounds obtainable from alkoxysilane compounds, and
- (2) polysiloxanes or modified polysiloxanes; and

an organic pigment coat formed on the coating layer comprising said organosilicon compound in an amount of from 1 to 100 parts by weight based on 100 parts by weight of said white inorganic particles.

[0020] In a sixth aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 10.0 μm , comprising:

- white inorganic particles as core particles;
- a gluing agent coating layer formed on surface of said white inorganic particle; and
- at least two colored adhesion layers composed of an organic pigment, formed on said coating layer through a gluing agent,
- the amount of the organic pigment being 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.

[0021] In a seventh aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 10.0 μm , comprising:

- white inorganic particles as core particles, each having on at least a part of the surface thereof, a coating layer comprising at least one compound selected from the group consisting of hydroxides of aluminum, oxides of aluminum, hydroxides of silicon and oxides of silicon;
- a gluing agent coating layer formed on surface of said white inorganic particle; and
- at least two colored adhesion layers composed of an organic pigment, formed on said coating layer through a gluing agent,
- the amount of the organic pigment being 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.

[0022] In an eighth aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 10.0 μm , comprising:

- white inorganic particles as core particles;
- a gluing agent coating layer formed on surface of said white inorganic particle, comprising at least one selected from the group consisting of a silane-based coupling agent, a titanate-based coupling agent, an aluminate-based coupling agent, a zirconate-based coupling agent, an oligomer compound, a polymer compound and an organosilicon compound selected from the group consisting of:

- (1) organosilane compounds obtainable from alkoxysilane compounds,
- (2) polysiloxanes or modified polysiloxanes, and
- (3) fluoroalkyl organosilane compounds obtainable from fluoroalkylsilane compounds; and

- at least two colored adhesion layers composed of an organic pigment, formed on said coating layer through a gluing agent comprising at least one selected from the group consisting of a silane-based coupling agent, a titanate-based coupling agent, an aluminate-based coupling agent, a zirconate-based coupling agent, an oligomer compound, a polymer compound and an organosilicon compound selected from the group consisting of: (1) organosilane compounds obtainable from alkoxysilane compounds, (2) polysiloxanes or modified polysiloxanes, and (3) fluoroalkyl organosilane compounds obtainable from fluoroalkylsilane compounds,
- the amount of the organic pigment being 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.

[0023] In a ninth aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 10.0 μm , comprising:

- white inorganic particles as core particles, each having on at least a part of the surface thereof, a coating layer comprising at least one compound selected from the group consisting of hydroxides of aluminum, oxides of aluminum, hydroxides of silicon and oxides of silicon;
- a gluing agent coating layer formed on surface of said white inorganic particle, comprising at least one selected from the group consisting of a silane-based coupling agent, a titanate-based coupling agent, an aluminate-based

coupling agent, a zirconate-based coupling agent, an oligomer compound, a polymer compound and an organosilicon compound selected from the group consisting of:

- (1) organosilane compounds obtainable from alkoxysilane compounds,
- (2) polysiloxanes or modified polysiloxanes, and
- (3) fluoroalkyl organosilane compounds obtainable from fluoroalkylsilane compounds; and

at least two colored adhesion layers composed of an organic pigment, formed on said coating layer through a gluing agent comprising at least one selected from the group consisting of a silane-based coupling agent, a titanate-based coupling agent, an aluminate-based coupling agent, a zirconate-based coupling agent, an oligomer compound, a polymer compound and an organosilicon compound selected from the group consisting of: (1) organosilane compounds obtainable from alkoxysilane compounds, (2) polysiloxanes or modified polysiloxanes, and (3) fluoroalkyl organosilane compounds obtainable from fluoroalkylsilane compounds, the amount of the organic pigment being 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.

[0024] In a tenth aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 0.5 μm , comprising:

extender pigment particles as core particles;
a gluing agent coating layer formed on surface of said white extender pigment particle, comprising an organosilicon compound, a coupling agent, an oligomer compound or a polymer compound; and
an organic pigment coat formed on the gluing agent coating layer in an amount of from 1 to 500 parts by weight based on 100 parts by weight of said extender pigment particles.

[0025] In an eleventh aspect of the present invention, there are provided composite particles having an average particle diameter of 0.001 to 0.15 μm , comprising:

extender pigment particles as core particles, each having on at least a part of the surface thereof, a coating layer comprising at least one compound selected from the group consisting of hydroxides of aluminum, oxides of aluminum, hydroxides of silicon and oxides of silicon;
a gluing agent coating layer formed on surface of said white extender pigment particle, comprising an organosilicon compound, a coupling agent, an oligomer compound or a polymer compound; and
an organic pigment coat formed on the gluing agent coating layer in an amount of from 1 to 500 parts by weight based on 100 parts by weight of said extender pigment particles.

[0026] In a twelfth aspect of the present invention, there is provided a process for producing composite particles, comprising:

mixing white inorganic particles with a gluing agent under stirring to form a gluing agent coating layer on surface of said white inorganic particle; and
mixing an organic pigment with the gluing agent-coated white inorganic particles under stirring to form an organic pigment coat on the gluing agent coating layer.

[0027] In a thirteenth aspect of the present invention, there are provided a pigment comprising the composite particles defined in any one of the above-mentioned aspects.

[0028] In a fourteenth aspect of the present invention, there is provided a paint comprising:

said pigment defined in the above aspect; and a paint base material.

[0029] In a fifteenth aspect of the present invention, there is provided a rubber or resin composition comprising:

said pigment defined in the above aspect; and
a base material for rubber or resin composition.

[0030] In a sixteenth aspect of the present invention, there is provided a pigment dispersion for solvent-based paint comprising:

100 parts by weight of a pigment dispersion base material for solvent-based paint; and
5 to 1,000 parts by weight of the pigment defined in the above aspect.

[0031] In a seventeenth aspect of the present invention, there is provided a pigment dispersion for water-based paint comprising:

100 parts by weight of a pigment dispersion base material for water-based paint; and
5 to 1,000 parts by weight of the pigment defined in the above aspect.

[0032] In an eighteenth aspect of the present invention, there is provided master batch pellets comprising:

100 parts by weight of rubber or thermoplastic resins; and
1 to 100 parts by weight of the pigment defined in the above aspect.

[0033] The present invention will now be described in detail below.

[0034] First, the composite particles according to the present invention are described.

[0035] The composite particles according to the present invention, comprise white inorganic particles, a gluing agent coating layer formed on surface of the white inorganic particles, and an organic pigment coat adhered onto the surface of the white inorganic particle through the gluing agent coating layer. The composite particles have an average particle size of 0.001 to 10.0 μm .

[0036] As the white inorganic particles used in the present invention, there may be exemplified white pigments such as titanium dioxide, transparent titanium dioxide and zinc oxide; pearl pigments such as titanium mica and muscovite; and extender pigments such as fine silica particles such as silica powder, white carbon, fine silicic acid powder and diatomaceous earth, clay, calcium carbonate, precipitated barium sulfate, alumina white, talc, transparent titanium oxide and satin white. The white inorganic particles may be appropriately selected from the above-described pigments according to properties required therefor or applications thereof, for example, the white pigments are preferably used in applications requiring a hiding power, and the pearl pigments are preferably used in applications requiring pearl-like gloss. In addition, transparent titanium dioxide, the extender pigments or pearl pigments are preferably used in applications requiring a transparency. Among them, the extender pigments are more preferred.

[0037] The white inorganic particles may be those having any suitable shape such as spherical particles, granular particles, polyhedral particles, acicular particles, spindle-shaped particles, rice grain-like particles, flake-shaped particles, scale-like particles and plate-shaped particles.

[0038] The lower limit of the average particle size of the white inorganic particles is usually 0.0009 μm , preferably 0.002 μm , more preferably 0.004 μm , still more preferably 0.009 μm . The upper limit of the average particle size of the white inorganic particles is usually 9.95 μm , preferably 9.45 μm , more preferably 8.95 μm . In some specific applications, the upper limit of the average particle size of the white inorganic particles is preferably 0.49 μm , more preferably 0.29 μm , still more preferably 0.14 μm .

[0039] When the average particle size of the white inorganic particles is more than 9.95 μm , the obtained composite particles become coarse, resulting in deteriorated tinting strength thereof. When the average particle size of the white inorganic particles is less than 0.0009 μm , such particles tend to be agglomerated due to such fine particles. As a result, it becomes difficult to form a uniform gluing agent coating layer on the surface of the white inorganic particles, and uniformly adhere an organic pigment onto the surface of the coating layer.

[0040] The white inorganic particles usually have a BET specific surface area value of not less than 0.5 m^2/g . When the BET specific surface area value is less than 0.5 m^2/g , the white inorganic particles become coarse, or sintering is caused within or between the particles, so that the obtained composite particles also become coarse and are, therefore, deteriorated in tinting strength. In the consideration of tinting strength of the obtained composite particles, the BET specific surface area value of the white inorganic particles is preferably not less than 1.0 m^2/g , more preferably 1.5 m^2/g . In the consideration of forming a uniform gluing agent coating layer on the surface of the white inorganic particles or uniformly adhering the organic pigment onto the surface of the gluing agent coating layer, the upper limit of the BET specific surface area value of the white inorganic particles is usually 500 m^2/g , preferably 400 m^2/g , more preferably 300 m^2/g .

[0041] As to the hue of the white inorganic particles, the L^* value thereof is preferably not less than 70.00, more preferably not less than 75.00, and the C^* value thereof is preferably not more than 18.00, more preferably not more than 16.00, still more preferably not more than 12.00, further still more preferably not more than 10.00, most preferably not more than 8.00. When the L^* value is out of the above-specified ranges, the inorganic particles may not exhibit a sufficiently white color, so that it may become difficult to obtain the aimed composite particles of the present invention.

[0042] As to the hiding power of the white inorganic particles used in the present invention, in the case where white pigments is used as the white inorganic particles, the hiding power thereof not less than 600 cm^2/g when measured

by the below-mentioned method, and in the case where transparent titanium dioxide, pearl pigments or extender pigments are used as the white inorganic particles, the hiding power thereof is less than 600 cm²/g.

[0043] In order to obtain the composite particles having a good transparency, the hiding power of the white inorganic particles is preferably less than 200 cm²/g, more preferably not more than 150 cm²/g, still more preferably not more than 100 cm²/g.

[0044] As to the light resistance of the white inorganic particles used in the present invention, the lower limit of the ΔE^* value thereof is more than 5.0, and the upper limit of the ΔE^* value is usually 12.0, preferably 11.0, more preferably 10.0.

[0045] The gluing agent used in the present invention may be of any kind as long as the organic pigment can be adhered onto the surface of the white inorganic particle therethrough. Examples of the preferred gluing agents may include organosilicon compounds such as alkoxysilanes, fluoroalkylsilanes and polysiloxanes; various coupling agents such as silane-based coupling agents, titanate-based coupling agents, aluminate-based coupling agents and zirconate-based coupling agents; oligomer compounds, polymer compounds or the like. These gluing agents may be used alone or in the form of a mixture of any two or more thereof. In the consideration of adhesion strength of the organic pigment onto the surface of the white inorganic particle through the gluing agent, the more preferred gluing agents are the organosilicon compounds such as alkoxysilanes, fluoroalkylsilanes and polysiloxanes, and various coupling agents such as silane-based coupling agents, titanate-based coupling agents, aluminate-based coupling agents and zirconate-based coupling agents.

[0046] In particular, in the case where fine silica particles are used as the core particles, it is preferable to use the organosilicon compounds or the silane-based coupling agents as the gluing agent.

[0047] As organosilicon compounds used in the present invention, at least one organosilicon compound selected from the group consisting of (1) organosilane compounds obtained from alkoxysilane compounds; (2) polysiloxanes, or modified polysiloxanes selected from the group consisting of (2-A) polysiloxanes modified with at least one compound selected from the group consisting of polyethers, polyesters and epoxy compounds (hereinafter referred to merely as "modified polysiloxanes"), and (2-B) polysiloxanes whose molecular terminal is modified with at least one group selected from the group consisting of carboxylic acid groups, alcohol groups and a hydroxyl group; and (3) fluoroalkyl organosilane compounds obtained from fluoroalkylsilane compounds.

[0048] The organosilane compounds (1) can be produced from alkoxysilane compounds represented by the formula (I):

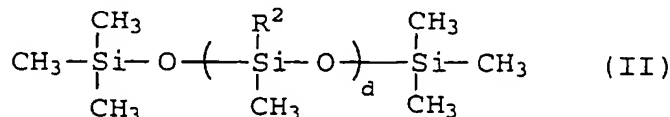


wherein R¹ is C₆H₅-, (CH₃)₂CHCH₂- or n-C_bH_{2b+1}- (wherein b is an integer of 1 to 18); X is CH₃O- or C₂H₅O-; and a is an integer of 0 to 3.

[0049] The alkoxysilane compounds may be dried or heat-treated, for example, at a temperature of usually 40 to 150°C, preferably 60 to 120°C for usually 10 minutes to 12 hours, preferably 30 minutes to 3 hours.

[0050] Specific examples of the alkoxysilane compounds may include methyltriethoxysilane, dimethyldiethoxysilane, phenyltriethoxysilane, diphenyldiethoxysilane, methyltrimethoxysilane, dimethyldimethoxysilane, phenyltrimethoxysilane, diphenyldimethoxysilane, isobutyltrimethoxysilane, decyltrimethoxysilane or the like. Among these alkoxysilane compounds, in view of the desorption percentage and the adhering effect of the organic pigments, methyl triethoxysilane, phenyltriethoxysilane, methyltrimethoxysilane, dimethyldimethoxysilane and isobutyltrimethoxysilane are preferred, and methyltriethoxysilane, methyltrimethoxysilane and phenyltriethoxysilane are more preferred.

[0051] As the polysiloxanes (2), there may be used those compounds represented by the formula (II):

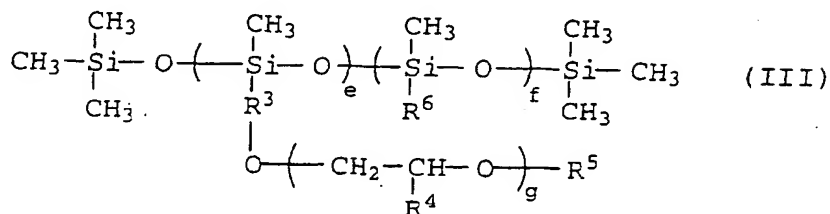


wherein R² is H- or CH₃-, and d is an integer of 15 to 450.

[0052] Among these polysiloxanes, in view of the desorption percentage and the adhering effect of the organic pigment, polysiloxanes having methyl hydrogen siloxane units are preferred.

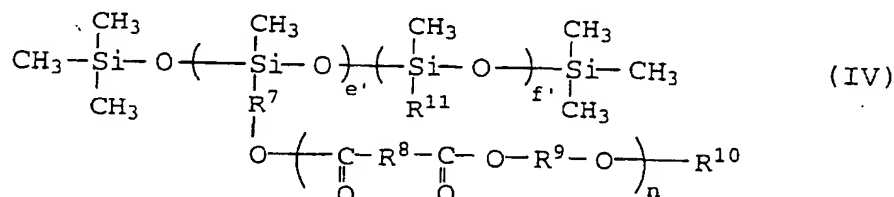
[0053] As the modified polysiloxanes (2-A), there may be used:

(a1) polysiloxanes modified with polyethers represented by the formula (III):



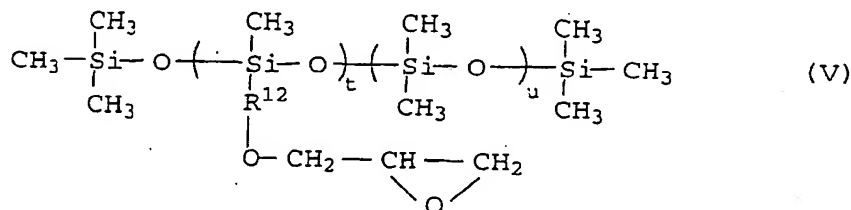
wherein R^3 is $-(\text{CH}_2)_h-$; R^4 is $-(\text{CH}_2)_i-\text{CH}_3$; R^5 is $-\text{OH}$, $-\text{COOH}$, $-\text{CH}=\text{CH}_2$, $-\text{CH}(\text{CH}_3)=\text{CH}_2$ or $-(\text{CH}_2)_j-\text{CH}_3$; R^6 is $-(\text{CH}_2)_k-\text{CH}_3$; g and h are an integer of 1 to 15; i , j and k are an integer of 0 to 15; e is an integer of 1 to 50; and f is an integer of 1 to 300;

(a2) polysiloxanes modified with polyesters represented by the formula (IV):



wherein R^7 , R^8 and R^9 are $-(\text{CH}_2)_q-$ and may be the same or different; R^{10} is $-\text{OH}$, $-\text{COOH}$, $-\text{CH}=\text{CH}_2$, $-\text{CH}(\text{CH}_3)=\text{CH}_2$ or $-(\text{CH}_2)_r-\text{CH}_3$; R^{11} is $-(\text{CH}_2)_s-\text{CH}_3$; n and q are an integer of 1 to 15; r and s are an integer of 0 to 15; e' is an integer of 1 to 50; and f' is an integer of 1 to 300;

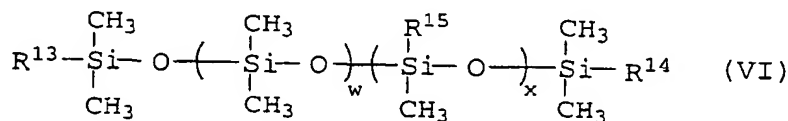
(a3) polysiloxanes modified with epoxy compounds represented by the formula (V):



wherein R^{12} is $-(\text{CH}_2)_v-$; v is an integer of 1 to 15; t is an integer of 1 to 50; and u is an integer of 1 to 300; or a mixture thereof.

[0054] Among these modified polysiloxanes (2-A), in view of the desorption percentage and the adhering effect of the organic pigment, the polysiloxanes modified with the polyethers represented by the formula (III), are preferred.

[0055] As the terminal-modified polysiloxanes (2-B), there may be used those represented by the formula (VI):



wherein R^{13} and R^{14} are $-\text{OH}$, R^{16}OH or R^{17}COOH and may be the same or different; R^{15} is $-\text{CH}_3$ or $-\text{C}_6\text{H}_5$; R^{16} and

R¹⁷ are $-(\text{CH}_2)_y-$; wherein y is an integer of 1 to 15; w is an integer of 1 to 200; and x is an integer of 0 to 100.

[0056] Among these terminal-modified polysiloxanes, in view of the desorption percentage and the adhering effect of the organic pigment, the polysiloxanes whose terminals are modified with carboxylic acid groups are preferred.

[0057] The fluoroalkyl organosilane compounds (3) may be produced from fluoroalkylsilane compounds represented by the formula (VII):



wherein R¹⁸ is CH₃-, C₂H₅-, CH₃O- or C₂H₅O-; X is CH₃O- or C₂H₅O-; and z is an integer of 0 to 15; and a' is an integer of 0 to 3.

[0058] The fluoroalkylsilane compounds may be dried or heat-treated, for example, at a temperature of usually 40 to 150°C, preferably 60 to 120°C for usually 10 minutes to 12 hours, preferably 30 minutes to 3 hours.

[0059] Specific examples of the fluoroalkylsilane compounds may include trifluoropropyl trimethoxysilane, tridecafluorooctyl trimethoxysilane, heptadecafluorodecyl trimethoxysilane, heptadecafluorodecylmethyl dimethoxysilane, trifluoropropyl triethoxysilane, tridecafluorooctyl triethoxysilane, heptadecafluorodecyl triethoxysilane, heptadecafluorodecylmethyl diethoxysilane or the like. Among these fluoroalkylsilane compounds, in view of the desorption percentage and the adhering effect of the organic pigment, trifluoropropyl trimethoxysilane, tridecafluorooctyl trimethoxysilane and heptadecafluorodecyl trimethoxysilane are preferred, and trifluoropropyl trimethoxysilane and tridecafluorooctyl trimethoxysilane are more preferred.

[0060] As the silane-based coupling agents, there may be exemplified vinyltrimethoxysilane, vinyltriethoxysilane, γ -aminopropyltriethoxysilane, γ -glycidoxypropyltrimethoxysilane, γ -mercaptopropyltrimethoxysilane, γ -methacryloxypropyltrimethoxysilane, N- β (aminoethyl)- γ -aminopropyltrimethoxysilane, γ -glycidoxypropylmethyldimethoxysilane, γ -chloropropyltrimethoxysilane or the like.

[0061] As the titanate-based coupling agents, there may be exemplified isopropyltristearoyl titanate, isopropyltris(diocetylpyrophosphate)titanate, isopropyltri(N-aminoethyl-aminoethyl)titanate, tetraoctylbis(ditridecylphosphate)titanate, tetra(2,2-diaryloxymethyl-1-butyl)bis(ditridecyl)phosphate titanate, bis(diocetylpyrophosphate)oxyacetate titanate, bis(diocetylpyrophosphate)ethylene titanate or the like.

[0062] As the aluminate-based coupling agents, there may be exemplified acetoalkoxyaluminum diisopropilate, aluminumdiisopropoxymonoethylacetoacetate, aluminumtrisethylacetoacetate, aluminumtrisacetylacetonate or the like.

[0063] As the zirconate-based coupling agents, there may be exemplified zirconiumtetrakisacetylacetonate, zirconiumdibutoxybisacetylacetonate, zirconiumtetrakisethylacetoacetate, zirconiumtributoxymonoethylacetoacetate, zirconiumtributoxyacetylacetonate or the like.

[0064] It is preferred to use oligomer compounds having a molecular weight of from 300 to less than 10,000. It is preferred to use polymer compounds having a molecular weight of about 10,000 to about 100,000. In the consideration of forming a uniform coating layer on the white inorganic particles, the oligomers or polymer compounds are preferably in a liquid state, or soluble in water or various solvents.

[0065] The amount of the gluing agent coating layer is preferably 0.01 to 15.0% by weight, more preferably 0.02 to 12.5% by weight, still more preferably 0.03 to 10.0% by weight (calculated as C) based on the weight of the gluing agent-coated white inorganic particles, in the case where the coupling agent except for the silane-based coupling agents, oligomers or polymer compounds are used as the gluing agent.

[0066] When the amount of the gluing agent-coating layer is less than 0.01% by weight, it may be difficult to adhere not less than one part by weight of the organic pigment onto 100 parts by weight of the white inorganic particles. When the amount of the gluing agent coating layer is more than 15.0% by weight, since it is possible to adhere 1 to 500 parts by weight of the organic pigment onto 100 parts by weight of the white inorganic particles therethrough, it is unnecessary to form the gluing agent coating layer in an amount of more than 15.0% by weight.

[0067] In the case where the organosilicon compounds or silane-based coupling agents are used as the gluing agent, the amount of the coating organosilicon compounds or silane-based coupling agents is preferably 0.02 to 5.0% by weight, more preferably 0.03 to 4.0% by weight, still more preferably 0.05 to 3.0% by weight (calculated as Si) based on the weight of the white inorganic particles coated with the organosilicon compounds or silane-based coupling agents.

[0068] When the amount of the coating organosilicon compounds is less than 0.02% by weight, it may become difficult to adhere not less than one part by weight of the organic pigment onto 100 parts by weight of the white inorganic particles. When the amount of the coating organosilicon compounds is more than 5.0% by weight, since it is possible to adhere 1 to 500 parts by weight of the organic pigment onto 100 parts by weight of the white inorganic particles, it is unnecessary to form a coating layer of the organosilicon compounds in an amount of more than 5.0% by weight.

[0069] As the organic pigment used in the present invention, there may be exemplified various organic pigments

ordinarily used as colorants of paints, inks and resin compositions, such as organic red-based pigments, organic blue-based pigments, organic yellow-based pigments and organic green-based pigments.

[0070] Examples of the organic red-based pigments may include quinacridon pigments such as quinacridon red, azo-based pigments such as permanent red, condensed azo pigments such as condensed azo red, perylene pigment such as perylene red or the like.

[0071] Examples of the organic blue-based pigments may include phthalocyanine-based pigments such as metal-free phthalocyanine blue, phthalocyanine blue and fast sky blue.

[0072] Examples of the organic yellow-based pigments may include monoazo-based pigments such as Hanza yellow, disazo-based pigments such as benzidine yellow and permanent yellow, condensed azo pigments such as condensed azo yellow, or the like.

[0073] Examples of the organic green-based pigments may include phthalocyanine-based pigments such as phthalocyanine green.

[0074] Meanwhile, these organic pigments may be used in the form of a mixture of any two or more thereof depending upon the hue required.

[0075] In the composite particles of the present invention, a plurality of organic pigment coats composed of the above organic pigments may be formed on the surface of the white inorganic particle as core particles through the gluing agent. For example, after forming the gluing agent coating layer on the surface of the core particle, an organic pigment coat (hereinafter referred to merely as "first colored adhesion layer") is formed by adhering the organic pigment onto the gluing agent coating layer. Then, after further forming a gluing agent coating layer on the first colored adhesion layer, an organic pigment coat (hereinafter referred to merely "second colored adhesion layer") is formed by adhering the organic pigment onto the gluing agent coating layer. The same procedure as described above may be repeated to form three or more colored adhesion layers on the surface of the white inorganic particles, if required.

[0076] Meanwhile, the organic pigments contained in the first and second colored adhesion layers may be the same or different in kinds or colors. In this case, when organic pigments having different specific functions such as light resistance are used in combination, it is possible to obtain composite particles having a plurality of functions.

[0077] The amount of the organic pigment adhered is usually 1 to 500 parts by weight, preferably 1 to 400 parts by weight, more preferably 1 to 300 parts by weight, still more preferably 1 to 200 parts by weight, further still more preferably 1 to 100 parts by weight, furthermore still more preferably 1 to 75 parts by weight, most preferably 1 to 50 parts by weight based on 100 parts by weight of the white inorganic particles.

[0078] When the amount of the organic pigment adhered is less than one part by weight, the amount of the organic pigment coated on the white inorganic particles is too small, so that it may become difficult to obtain the aimed composite particles of the present invention. When the amount of the organic pigment adhered is more than 500 parts by weight, the organic pigment may tend to be desorbed from the white inorganic particles because of too large amount of the organic pigment adhered. As a result, the obtained composite particles may be deteriorated in dispersion stability.

[0079] In the case where a plurality of colored adhesion layers are formed on the surface of the white inorganic particle, the amount of the organic pigment adhered for each colored adhesion layer may be appropriately determined according to aimed hue and properties such that the total amount of the organic pigments adhered for whole colored adhesion layers does not exceed the above-mentioned upper limit thereof.

[0080] The shape and size of the composite particles according to the present invention may vary depending upon those of the white inorganic particles as core particles. The composite particles usually have a configuration or shape similar to that of the core particles.

[0081] Specifically, the lower limit of average particle size of the composite particles according to the present invention is usually 0.001 μm , preferably 0.003 μm , more preferably 0.005 μm , still more preferably 0.01 μm . The upper limit of average particle size of the composite particles according to the present invention is usually 10.0 μm , preferably 9.5 μm , more preferably 9.0 μm .

[0082] When the average particle size of the composite particles is more than 10.0 μm , the composite particles may be deteriorated in tinting strength because of too large particle size thereof. When the average particle size of the composite particles is less than 0.001 μm , the composite particles may tend to be agglomerated together due to such fine particles, so that it may become difficult to disperse the composite particles in paint vehicles or resin compositions.

[0083] The lower limit of BET specific surface area value of the composite particles according to the present invention is usually 1.0 m^2/g , preferably 1.5 m^2/g , more preferably 2.0 m^2/g . The upper limit of BET specific surface area value of the composite particles according to the present invention is preferably 500 m^2/g , more preferably 400 m^2/g , still more preferably 300 m^2/g . In some specific applications, the BET specific surface area value of the composite particles is preferably not more than 100 m^2/g , more preferably not more than 95 m^2/g , still more preferably not more than 90 m^2/g .

[0084] When the BET specific surface area value of the composite particles is less than 1.0 m^2/g , the obtained composite particles may become coarse, or sintering may be caused within or between the particles, resulting in deteriorated tinting strength. When the BET specific surface area value of the composite particles is more than 500 m^2/g ,

g, the obtained particles may tend to be agglomerated together due to such fine particles, resulting in deteriorated dispersibility in paint or ink vehicles, or resin compositions.

[0085] The desorption percentage of the organic pigment from the composite particles is preferably not more than 10%, more preferably not more than 9%.

[0086] Also, in the case where the specific gravity of the organic pigment is close to that of the composite particles, the degree of desorption of the organic pigment from the composite particles is preferably the rank 5 or 4, more preferably the rank 5 when visually observed and evaluated by the below-mentioned method. When the desorption percentage of the organic pigment from the composite particles is more than 10% or when the degree of desorption of the organic pigment from the composite particles is the rank 1, 2 or 3, uniform dispersion of the composite particles in paint vehicles or resin compositions may tend to be inhibited by the desorbed organic pigment. In addition, the hue of the white inorganic particles themselves is exposed outside at portions from which the organic pigment is desorbed, so that it may become difficult to obtain composite particles having a uniform hue.

[0087] The tinting strength of the composite particles according to the present invention is preferably not less than 110%, more preferably not less than 115%, still more preferably not less than 120% when measured by the below-mentioned evaluation method.

[0088] In the case where white pigments are used as the white inorganic particles, the hiding power of the obtained composite particles according to the present invention is preferably not less than 700 cm²/g, more preferably not less than 750 cm²/g when measured by the below-mentioned evaluation method. In the case where transparent titanium dioxide, extender pigments or pearl pigments are used as the white inorganic particles, the hiding power of the obtained composite particles is preferably less than 700 cm²/g, more preferably not more than 650 cm²/g, still more preferably not more than 600 cm²/g, further still more preferably not more than 560 cm²/g.

[0089] As to the light resistance of the composite particles according to the present invention, the ΔE^* value thereof is usually not more than 5.0, preferably not more than 4.0 when measured by the below-mentioned evaluation method. In particular, when particles having an ultraviolet light-preventing effect, such as titanium oxide and zinc oxide are used as the core particles, the ΔE^* value of the composite particles is preferably not more than 3.0, more preferably not more than 2.0.

[0090] In the composite particles according to the present invention, if required, the surface of the white inorganic particle may be previously coated with at least one compound selected from the group consisting of hydroxides of aluminum, oxides of aluminum, hydroxides of silicon and oxides of silicon (hereinafter referred to as "hydroxides and/or oxides of aluminum and/or silicon coat"). The composite particles using the white inorganic particles having the hydroxides and/or oxides of aluminum and/or silicon coat, can be more effectively prevented from undergoing desorption of organic pigment from the surface of the white inorganic particle, and can exhibit a higher light resistance, as compared to composite particles using the white inorganic particles having no hydroxides and/or oxides of aluminum and/or silicon.

[0091] The amount of the hydroxides and/or oxides of aluminum and/or silicon coat is 0.01 to 20% by weight (calculated as Al, SiO₂ or sum of Al and SiO₂) based on the weight of the white inorganic particles coated with the hydroxides and/or oxides of aluminum and/or silicon coat.

[0092] When the amount of the hydroxides and/or oxides of aluminum and/or silicon coat is less than 0.01% by weight, it may be difficult to attain the improved effect of reducing the desorption percentage of organic pigment or the improved effect of enhancing the light resistance. As long as the amount of the hydroxides and/or oxides of aluminum and/or silicon coat is in the range of 0.01 to 20% by weight, the improved effect of reducing the desorption percentage of organic pigment or the improved effect of enhancing the light resistance can be sufficiently attained. Therefore, it is unnecessary to form the hydroxides and/or oxides of aluminum and/or silicon coat in an amount of more than 20% by weight.

[0093] The composite particles having a hydroxides and/or oxides of aluminum and/or silicon coat according to the present invention are substantially the same in particle size, BET specific surface area value, hue (L^* value, a^* value and b^* value), tinting strength and hiding power as those of the composite particles having no hydroxides and/or oxides of aluminum and/or silicon coat according to the present invention. The desorption percentage of the organic pigment from the composite particles can be improved by forming an intermediate coat (the hydroxides and/or oxides of aluminum and/or silicon coat), on the white inorganic particles. Specifically, by forming such the intermediate coat on the white inorganic particles, the properties of the composite particles can be improved such that the desorption percentage of the organic pigment therefrom is preferably not more than 8%, more preferably not more than 6%, and as to the light resistance, the ΔE^* value thereof is usually not more than 4.0, preferably 3.0.

[0094] The pigment according to the present invention comprises the above composite particles.

[0095] Next, the paint containing the pigment according to the present invention will be described.

[0096] The solvent-based paint containing the pigment according to the present invention has such a storage stability that the ΔE^* value thereof is usually not more than 1.5, preferably not more than 1.2. When the paint is formed into a coating film, the gloss of the coating film is usually 75 to 110%, preferably 80 to 110%. As to the light resistance of the

coating film, the ΔE^* value thereof is usually not more than 5.0, preferably not more than 4.0. Meanwhile, in the case where transparent titanium dioxide, the extender pigment or pearl pigment is used as the white inorganic particles, the coating film has such a transparency that the linear absorption thereof is usually not more than $0.10 \mu\text{m}^{-1}$, preferably not more than $0.09 \mu\text{m}^{-1}$.

[0097] The solvent-based paint blended with the pigment using the white inorganic particles coated with the hydroxides and/or oxides of aluminum and/or silicon, has such a storage stability that the ΔE^* value thereof is usually not more than 1.5, preferably not more than 1.2. When the paint is formed into a coating film, the gloss of the coating film is usually 80 to 115%, preferably 85 to 115%. The coating film has such a light resistance that the ΔE^* value thereof is usually not more than 4.0, preferably not more than 3.0. When transparent titanium dioxide, the extender pigment or pearl pigment is used as the white inorganic particles, the coating film has such a transparency that the linear absorption thereof is usually not more than $0.10 \mu\text{m}^{-1}$, preferably not more than $0.09 \mu\text{m}^{-1}$.

[0098] The water-based paint containing the pigment according to the present invention has such a storage stability that the ΔE^* value thereof is usually not more than 1.5, preferably not more than 1.2. When the water-based paint is formed into a coating film, the gloss of the coating film is usually 70 to 110%, preferably 75 to 110%. The coating film has such a light resistance that the ΔE^* value thereof is usually not more than 5.0, preferably not more than 4.0. Meanwhile, when transparent titanium dioxide, the extender pigment or pearl pigment is used as the white inorganic particles, the coating film produced from the water-based paint has such a transparency that the linear absorption thereof is usually not more than $0.11 \mu\text{m}^{-1}$, preferably not more than $0.10 \mu\text{m}^{-1}$.

[0099] The water-based paint blended with the pigment using the white inorganic particles coated with the hydroxides and/or oxides of aluminum and/or silicon, has such a storage stability that the ΔE^* value thereof is usually not more than 1.5, preferably not more than 1.2. When such a water-based paint is formed into a coating film, the gloss of the coating film is usually 75 to 115%, preferably 80 to 115%. The coating film has such a light resistance that the ΔE^* value thereof is usually not more than 4.0, preferably not more than 3.0. When transparent titanium dioxide, the extender pigment or pearl pigment is used as the white inorganic particles, the coating film produced from the water-based paint has such a transparency that the linear absorption thereof is usually not more than $0.11 \mu\text{m}^{-1}$, preferably not more than $0.09 \mu\text{m}^{-1}$.

[0100] The amount of the pigment blended in the paint according to the present invention is in the range of usually 0.5 to 100 parts by weight based on 100 parts by weight of a paint base material. In the consideration of handling of the paint, the amount of the pigment blended in the paint is preferably 1.0 to 100 parts by weight based on 100 parts by weight of the paint base material.

[0101] The paint base material comprises a resin and a solvent, and may further contain, if required, a defoamer, an extender pigment, a drying agent, a surfactant, a hardening accelerator, an assistant or the like.

[0102] Examples of the resins used in the paint base material for solvent-based paints may include those ordinarily used for solvent-based paints or oil-based printing inks such as acrylic resins, alkyd resins, polyester resins, polyurethane resins, epoxy resins, phenol resins, melamine resins, amino resins, vinyl chloride resins, silicone resins, rosin-based resins such as gum rosin and lime rosin, maleic acid resins, polyamide resins, nitrocellulose, ethylene-vinyl acetate copolymer resins, rosin-modified resins such as rosin-modified phenol resins and rosin-modified maleic acid resins, petroleum resins or the like. Examples of the resins used in the paint base material for water-based paints may include those ordinarily used for water-based paints or aqueous inks such as water-soluble acrylic resins, water-soluble styrene-maleic acid copolymer resins, water-soluble alkyd resins, water-soluble melamine resins, water-soluble urethane emulsion resins, water-soluble epoxy resins, water-soluble polyester resins or the like.

[0103] As the solvent for solvent-based paints, there may be exemplified those solvents ordinarily used for solvent-based paints or oil-based printing inks such as soybean oil, toluene, xylene, thinner, butyl acetate, methyl acetate, methyl isobutyl ketone, glycol ether-based solvents such as methyl cellosolve, ethyl cellosolve, propyl cellosolve, butyl cellosolve and propylene glycol monomethyl ether, ester-based solvents such as ethyl acetate, butyl acetate and amyl acetate, aliphatic hydrocarbon-based solvents such as hexane, heptane and octane, alicyclic hydrocarbon-based solvents such as cyclohexane, petroleum-based solvents such as mineral spirits, ketone-based solvents such as acetone and methyl ethyl ketone, alcohol-based solvents such as methyl alcohol, ethyl alcohol, propyl alcohol and butyl alcohol, aliphatic hydrocarbons or the like.

[0104] As the solvents for water-based paints, there may be used a mixture of water and a water-soluble organic solvent ordinarily used for water-based paints or aqueous inks such as alcohol-based solvents such as ethyl alcohol, propyl alcohol and butyl alcohol, glycol ether-based solvents such as methyl cellosolve, ethyl cellosolve, propyl cellosolve and butyl cellosolve, oxyethylene or oxypropylene addition polymers such as diethylene glycol, triethylene glycol, polyethylene glycol, dipropylene glycol, tripropylene glycol and polypropylene glycol, alkylene glycols such as ethylene glycol, propylene glycol and 1,2,6-hexanetriol, glycerin, 2-prolidone or the like.

[0105] As the fats and oils, there may be used boiled oils obtained by processing drying oils such as linseed oil, tung oil, oiticica oil and safflower oil.

[0106] As the defoamer, there may be used commercially available products such as "NOPCO 8034 (tradename)",

"SN DEFOAMER 477 (tradename)", "SN DEFOAMER 5013 (tradename)", "SN DEFOAMER 247 (tradename)" and "SN DEFOAMER 382 (tradename)" (all produced by SUN NOPCO CO., LTD.), "ANTI-FOAM 08 (tradename)" and "EMARGEN 903 (tradename)" (both produced by KAO CO., LTD.), or the like.

[0107] Next, the resin composition tinted with the pigment according to the present invention is described.

[0108] The resin composition tinted with the pigment according to the present invention exhibits a dispersing condition of usually the rank 4 or 5, preferably the rank 5 when visually observed and evaluated by the below-mentioned method, and a light resistance (ΔE^* value) of usually not more than 5.0, preferably not more than 4.0. When transparent titanium dioxide, the extender pigments or pearl pigment are used as the white inorganic particles, the transparency of the resin composition is such that the linear absorption thereof is usually not more than $0.10 \mu\text{m}^{-1}$, preferably not more than $0.09 \mu\text{m}^{-1}$.

[0109] When the resin composition is tinted with the pigment produced from the white inorganic particles coated with the hydroxides and/or oxides of aluminum and/or silicon, the dispersing condition thereof is usually the rank 4 or 5, preferably the rank 5 when visually observed and evaluated by the below-mentioned method, and the light resistance (ΔE^* value) thereof is usually not more than 4.0, preferably not more than 3.0. Meanwhile, when transparent titanium dioxide, the extender pigment or pearl pigment are used as the white inorganic particles, the transparency of the resin composition is such that the linear absorption thereof is usually not more than $0.10 \mu\text{m}^{-1}$, preferably not more than $0.09 \mu\text{m}^{-1}$.

[0110] The amount of the pigment blended in the resin composition according to the present invention is usually in the range of 0.01 to 200 parts by weight based on 100 parts by weight of resins contained in the composition. In the consideration of handling of the resin composition, the amount of the pigment blended therein is preferably 0.05 to 150 parts by weight, more preferably 0.1 to 100 parts by weight based on 100 parts by weight of the resins.

[0111] The base material of the resin composition according to the present invention comprises the pigment and known thermoplastic resins, and may further contain, if required, additives such as lubricants, plasticizers, antioxidants, ultraviolet light absorbers, various stabilizers or the like.

[0112] As the resins, there may be used polyolefins such as polyethylene, polypropylene, polybutene and polyisobutylene; thermoplastic resins such as polyvinyl chloride, polystyrene, styrene-acrylic ester copolymers, chlorinated resins, styrene-vinyl acetate copolymers and polyamides; rosin-modified maleic acid resins; phenol resins; epoxy resins; polyester resins; ionomer resins; polyurethane resins; silicone resins; rosin-esters; rosins; natural rubbers, synthetic rubbers; or the like.

[0113] The additives may be added in an amount of usually not more than 50% by weight based on the total amount of the pigment and the resin. When the amount of the additives added is more than 50% by weight, the obtained resin composition may be deteriorated in moldability.

[0114] The resin composition of the present invention is produced by previously intimately mixing the raw resin material with the pigment, and then kneading the resultant mixture using a kneader or an extruder under heating while applying a strong shear force thereto in order to deaggregate the agglomerated pigment and uniformly disperse the pigment in the resin. Then, the obtained resin composition is molded into an aimed shape upon use.

[0115] Next, the pigment dispersion for the production of paints and printing inks according to the present invention is described.

[0116] The pigment dispersion of the present invention contains a pigment paste and a mill base as an intermediate dispersion for paints and printing inks. Specifically, the pigment dispersion contains the pigment of the present invention in an amount of usually 5 to 1,000 parts by weight, preferably 10 to 800 parts by weight based on 100 parts by weight of the pigment dispersion base material.

[0117] The pigment dispersion base material contains a resin, a solvent and/or fats and oils, and may further contain, if required, defoamers, extender pigments, drying agents, surfactants, hardening accelerators, assistants or the like according to applications thereof.

[0118] As the resins for the pigment dispersion of the present invention, there may be used the same resins as those for the above-described paints.

[0119] As the solvents for the pigment dispersion of the present invention, there may be used the same solvents as those for the above-described paints.

[0120] As the fats and oils for the pigment dispersion of the present invention, there may be used the same fats and oils as those for the above-described paints.

[0121] The composition of the resin used in the pigment dispersion may be the same as or different from that of the diluting resin used for the production of paints. In the case where the resin used in the pigment dispersion is different from the diluting resin, the kinds of resins used may be determined in view of properties thereof so as to attain a good compatibility therebetween.

[0122] The pigment dispersion of the present invention can be produced by kneading and dispersing the pigment, the solvent and/or the fats and oils together using a dispersing device such as butterfly mixer, planetary mixer, pony mixer, dissolver, tank mixer, high-speed mixer, homomixer, kneader, roll mill, sand mill, attritor and ball mill.

[0123] The paint obtained by using the pigment dispersion of the present invention can exhibit a more excellent dispersibility.

[0124] Next, the master batch pellets used for the production of the paint and the resin composition of the present invention are described.

[0125] The master batch pellets of the present invention are produced (i) by mixing a binder resin as a base material for the paint or the resin composition with the pigment, if necessary, using a mixing device such as ribbon blender, Nauter mixer, Henschel mixer and Super mixer, kneading and molding the resultant mixture using a known single-screw kneading extruder or twin-screw kneading extruder, and then cutting the molded product into pellets; or (ii) by mixing a binder resin as a base material for the paint or the resin composition with the pigment, if necessary, using a mixing device such as ribbon blender, Nauter mixer, Henschel mixer and Super mixer, kneading the above mixture using Banbury mixer, press kneader or the like, and then pulverizing, molding or cutting the kneaded material into pellets.

[0126] The binder resin and the pigment may be respectively supplied in separate batches into the kneader at predetermined constant ratios, or may be simultaneously supplied thereto in the form of a mixture of both the components.

[0127] The master batch pellets of the present invention have an average major diameter of usually 1 to 6 mm, preferably 2 to 5 mm, and an average minor diameter of usually 2 to 5 mm, preferably 2.5 to 4 mm. When the average major diameter of the master batch pellets is less than 1 mm, the workability upon production of the pellets may be deteriorated. When the average major diameter of the master batch pellets is more than 6 mm, the master batch pellets are considerably different in size from that of diluting binder resin particles, so that it may be difficult to sufficiently disperse the pellets in the diluting binder resin. The master batch pellets may have any suitable shape such as an amorphous shape, a granular shape such as spherical shape, a cylindrical shape, a flake-like shape or the like.

[0128] As the binder resin for the master batch pellets of the present invention, there may be used resins of the same type as the above binder resin for the paint or the resin composition.

[0129] Meanwhile, the composition of the binder resin contained in the master batch pellets is preferably the same as that of the diluting binder resin. Also, the binder resin may be different from the diluting binder resin. In such a case, it is required that kinds of resins used are determined in view of various properties thereof so as to attain a good compatibility therebetween.

[0130] The amount of the pigment blended in the master batch pellets is usually 1 to 100 parts by weight, preferably 1 to 90 parts by weight, more preferably 1 to 80 parts by weight, still more preferably 5 to 25 parts by weight based on 100 parts by weight of the binder resin. When the amount of the pigment blended is less than 1 part by weight, the obtained master batch pellets may be insufficient in melt viscosity upon kneading, so that it may become difficult to sufficiently mix and disperse the pigment in the resin. When the amount of the pigment blended is more than 100 parts by weight, the amount of the binder resin may become comparatively small, so that it may also become difficult to sufficiently mix and disperse the pigment in the resin. In addition, since even a slight change in amount of the master batch pellets added causes a considerable change in content of the pigment in the resin composition, it may be difficult to control the content of the pigment in the resin composition to the aimed level. Further, mechanical abrasion of products produced from such master batch pellets becomes remarkable.

[0131] Next, the process for producing the composite particles according to the present invention is described.

[0132] The composite particles of the present invention can be produced by first mixing the white inorganic particles with the gluing agent to coat the surface of the white inorganic particle with the gluing agent, and then mixing the thus-obtained gluing agent-coated white inorganic particles with the organic pigment.

[0133] The formation of the gluing agent coating layer on the surface of the white inorganic particle or each colored adhesion layer may be conducted by mechanically mixing and stirring the particles with a gluing agent solution or the gluing agent, or by mechanically mixing and stirring the particles while spraying the gluing agent solution or the gluing agent thereonto. Substantially whole amount of the gluing agent added is adhered on the surface of the particles.

[0134] Meanwhile, in the case where alkoxysilanes or fluoroalkylsilanes are used as the gluing agent, a part of the alkoxysilanes or fluoroalkylsilanes may be coated in the form of organosilane compounds produced from the alkoxysilanes or fluoroalkyl organosilane compounds obtainable from fluoroalkylsilanes through the coating step. Even in such a case, subsequent adhesion of the organic pigment on the gluing agent-coating layer is not adversely affected.

[0135] In order to uniformly adhere the gluing agent over the surface of the white inorganic particles, it is preferred that the agglomerated white inorganic particles are previously deaggregated using a crusher.

[0136] The mixing and stirring of the white inorganic particles with the gluing agent, the mixing and stirring of the organic pigment with the gluing agent-coated white inorganic particles, the mixing and stirring of the gluing agent with the white inorganic particles coated with the organic pigment coat through the gluing agent, and the mixing and stirring of the organic pigment and the white inorganic particles having the colored adhesion layer and the gluing agent coating layer formed thereon, is preferably carried out using an apparatus capable of applying a shear force to the powder mixture, especially such an apparatus capable of simultaneously effecting shear action, spatula stroking and compression. Examples of such apparatuses may include wheel-type kneaders, ball-type kneaders, blade-type kneaders, roll-

type kneaders or the like. Among these apparatuses, the wheel-type kneaders are preferred to effectively practice the present invention.

[0137] Specific examples of the wheel-type kneaders may include edge runners (similar in meaning to mix muller, Simpson mill and sand mill), multimill, Stotz mill, Wet pan mill, corner mill, ring muller or the like. Among these kneaders, preferred are edge runners, multimill, Stotz mill, Wet pan mill and ring muller, and more preferred are edge runners. Specific examples of the ball-type kneaders may include vibration mill or the like. Specific examples of the blade-type kneaders may include Henschel mixer, planetary mixer, Nauter mixer or the like. Specific examples of the roll-type kneaders may include extruders or the like.

[0138] The conditions of the mixing and stirring treatment may be selected so as to uniformly coat the surface of the particle with the gluing agent. Specifically, the mixing and stirring conditions may be appropriately controlled such that the linear load is usually 19.6 to 1,960 N/cm (2 to 200 kg/cm), preferably 98 to 1,470 N/cm (10 to 150 kg/cm), more preferably 147 to 980 N/cm (15 to 100 kg/cm); the treating time is usually 5 minutes to 24 hours, preferably 10 minutes to 20 hours; and the stirring speed is usually 2 to 2,000 rpm, preferably 5 to 1,000 rpm, more preferably 10 to 800 rpm.

[0139] The amount of the gluing agent added is preferably 0.15 to 45 parts by weight based on 100 parts by weight of the white inorganic particles. When the gluing agent is added in an amount of 0.15 to 45 parts by weight, it is possible to adhere 1 to 500 parts by weight of the organic pigment onto 100 parts by weight of the white inorganic particles.

[0140] After the surface of the white inorganic particle is coated with the gluing agent, the organic pigment is added, and then mixed and stirred with the coated white inorganic particles to adhere the organic pigment onto the gluing agent coating layer. The obtained particles may be further subjected to drying or heating treatments, if required.

[0141] By varying an adding method of the organic pigments, mixing and stirring conditions, and an adhering configuration of the organic pigment coat, it is possible to adhere 1 to 500 parts by weight of the organic pigment onto the gluing agent coating layer.

[0142] As the adding method, a lump addition method, a continuous addition method, a divided addition method may be exemplified. When a large amount of the organic pigment is added, it is preferred to conduct the continuous addition method and the divided addition method.

[0143] As the adhering configuration of the organic pigment coat, a single organic pigment coat and a plurality of the organic pigment coats (organic pigment multilayered coat) may be exemplified. In case of a plurality of the organic pigment coats, the desorption percentage of the organic pigments is good as compared with that of the single organic pigment coat.

[0144] In case of continuously adding the organic pigments, the organic pigment may be added slowly and little by little, especially for a period of 5 minutes to 24 hours, preferably 5 minutes to 20 hours.

[0145] In case of dividedly adding the organic pigments, the adding step of the organic pigments of 5 to 25 parts by weight based on 100 parts by weight of the white inorganic particles, and mixing and stirring step under the following conditions can be repeated until the added amount of the organic pigments reaches a predetermined amount thereof.

[0146] The mixing and stirring conditions may be appropriately selected so as to form a uniform organic pigment coat on the gluing agent coating layer, and may be controlled such that the linear load is usually 19.6 to 1,960 N/cm (2 to 200 kg/cm), preferably 98 to 1,470 N/cm (10 to 150 kg/cm), more preferably 147 to 980 N/cm (15 to 100 kg/cm); the treating time is usually 5 minutes to 24 hours, preferably 10 minutes to 20 hours; and the stirring speed is usually 2 to 2,000 rpm, preferably 5 to 1,000 rpm, more preferably 10 to 800 rpm.

[0147] When a large amount of the organic pigment is added, it is preferred to lengthen the mixing and stirring time.

[0148] The amount of the organic pigment added is usually 1 to 500 parts by weight based on 100 parts by weight of the white inorganic particles. When the amount of the organic pigment added is out of the above-specified range, the aimed coloring material cannot be obtained.

[0149] The heating temperature used in the drying and heating treatments is preferably 40 to 150°C, more preferably 60 to 120°C, and the heating time is preferably 10 minutes to 12 hours, more preferably 30 minutes to 3 hours.

[0150] Meanwhile, in the case where alkoxysilanes are used as the gluing agent, the alkoxysilanes are finally coated in the form of organosilane compounds produced from the alkoxysilanes through these steps.

[0151] Alternatively, the composite particles having at least two colored adhesion layers each composed organic pigment coats through the gluing agent, can be produced by mixing the white inorganic particles with the gluing agent to coat the surface of the white inorganic particle with the gluing agent; mixing the organic pigment with the gluing agent-coated white inorganic particles to adhere the organic pigment onto the gluing agent coating layer, thereby forming a first colored adhesion layer; mixing the thus obtained primary composite particles having the first colored adhesion layer with the gluing agent; and then further mixing the obtained gluing agent-coated primary composite particles with the organic pigment to form an organic pigment coat onto the second gluing agent coating layer formed on the primary composite particles. Meanwhile, by repeating the coating with the gluing agent and the adhesion of the organic pigment according to requirements, it is possible to obtain such composite particles having three or more colored adhesion layers thereon.

[0152] The formation of the gluing agent coating layer on the surface of the white inorganic particle or each colored

adhesion layer may be conducted by mechanically mixing and stirring the particles with the gluing agent, or by mechanically mixing and stirring the particles while spraying the gluing agent thereonto. At this time, substantially whole amount of the gluing agent added is adhered on the surface of the particle.

[0153] Meanwhile, in the case where alkoxysilanes are used as the gluing agent, a part of the alkoxysilanes adhered may be coated in the form of organosilane compounds produced from the alkoxysilanes through the coating step. Even in such a case, the subsequent adhesion of the organic pigment onto the gluing agent-coating layer is not adversely affected.

[0154] The mixing and stirring of the white inorganic particles with the gluing agent, the mixing and stirring of the organic pigment with the gluing agent-coated white inorganic particles, the mixing and stirring of the gluing agent with the primary composite particles having the first colored adhesion layer thereon, and the mixing and stirring of the organic pigment with the primary composite particles having the first colored adhesion layer and the gluing agent coating layer formed thereon, is preferably carried out using an apparatus capable of applying a shear force to the powder mixture, especially such an apparatus capable of simultaneously effecting shear action, spatula stroking and compression. Examples of such apparatuses may include wheel-type kneaders, ball-type kneaders, blade-type kneaders or roll-type kneaders. Among these apparatuses, the wheel-type kneaders are preferred to effectively practice the present invention.

[0155] The conditions for mixing and stirring the white inorganic particles with the gluing agent may be appropriately selected so as to form a uniform gluing agent coating layer on the surface of the white inorganic particle. Specifically, the mixing and stirring conditions may be controlled such that the linear load is usually 19.6 to 1,960 N/cm (2 to 200 Kg/cm), preferably 98 to 1,470 N/cm (10 to 150 Kg/cm), more preferably 147 to 980 N/cm (15 to 100 Kg/cm); the treating time is usually 5 minutes to 24 hours, preferably 10 minutes to 20 hours; and the stirring speed is usually 2 to 2,000 rpm, preferably 5 to 1,000 rpm, more preferably 10 to 800 rpm.

[0156] The amount of the gluing agent added is preferably 0.15 to 45 parts by weight based on 100 parts by weight of the white inorganic particles. When the gluing agent is added in an amount of 0.15 to 45 parts by weight, it is possible to adhere 1 to 500 parts by weight of the organic pigment onto 100 parts by weight of the white inorganic particles.

[0157] After coating the surface of the white inorganic particle with the gluing agent, the organic pigment is added to the coated white inorganic particles, and the mixture is mixed and stirred together to form an organic pigment coat onto the gluing agent coating layer.

[0158] The organic pigment is preferably added slowly and little by little, especially for a period of 5 minutes to 24 hours, preferably 5 minutes to 20 hours.

[0159] The mixing and stirring conditions for forming the first colored adhesion layer may be appropriately selected so as to obtain a uniform organic pigment coat, and may be controlled such that the linear load is usually 19.6 to 1,960 N/cm (2 to 200 kg/cm), preferably 98 to 1,470 N/cm (10 to 150 kg/cm), more preferably 147 to 980 N/cm (15 to 100 kg/cm); the treating time is usually 5 minutes to 24 hours, preferably 10 minutes to 20 hours; and the stirring speed is usually 2 to 2,000 rpm, preferably 5 to 1,000 rpm, more preferably 10 to 800 rpm.

[0160] The upper limit of the amount of the organic pigment adhered for forming the first colored adhesion layer, is preferably 300 parts by weight, more preferably 200 parts by weight, still more preferably 150 parts by weight, further still more preferably 100 parts by weight based on 100 parts by weight of the white inorganic particles.

[0161] Then, the thus-obtained primary composite particles having the first colored adhesion layer is mixed with the gluing agent, and then the organic pigment is added to the resultant gluing agent-coated primary composite particles to adhere the organic pigment onto the first colored adhesion layer through the gluing agent, thereby forming a second colored adhesion layer. The obtained composite particles may be further subjected to drying or heating treatments, if required.

[0162] The conditions for mixing and stirring the primary composite particles with the gluing agent, may be appropriately selected so as to adhere the gluing agent on the surface of the primary composite particle, and may be controlled such that the linear load is usually 19.6 to 1,960 N/cm (2 to 200 kg/cm), preferably 98 to 1,470 N/cm (10 to 150 kg/cm), more preferably 147 to 980 N/cm (15 to 100 kg/cm); the treating time is usually 5 minutes to 24 hours, preferably 10 minutes to 20 hours; and the stirring speed is usually 2 to 2,000 rpm, preferably 5 to 1,000 rpm, more preferably 10 to 800 rpm.

[0163] The amount of the gluing agent added is preferably 0.15 to 45 parts by weight based on 100 parts by weight of the white inorganic particles. When the gluing agent is added in an amount of 0.15 to 45 parts by weight, it is possible to adhere 1 to 500 parts by weight of the organic pigment based onto 100 parts by weight of the white inorganic particles.

[0164] The mixing and stirring conditions for forming the second colored adhesion layer may be appropriately selected so as to form a uniform organic pigment coat onto the gluing agent coating layer, and may be controlled such that the linear load is usually 19.6 to 1,960 N/cm (2 to 200 kg/cm), preferably 98 to 1,470 N/cm (10 to 150 kg/cm), more preferably 147 to 980 N/cm (15 to 100 kg/cm); the treating time is usually 5 minutes to 24 hours, preferably 10 minutes to 20 hours; and the stirring speed is usually 2 to 2,000 rpm, preferably 5 to 1,000 rpm, more preferably 10 to 800 rpm.

[0165] The amount of the organic pigment added for forming the second colored adhesion layer may be appropriately determined according to the aimed hue and properties of the obtained composite particles such that the total amount of the organic pigment adhered does not exceed the upper limit thereof. The upper limit of the total amount of the organic pigment adhered is preferably 300 parts by weight, more preferably 200 parts by weight, still more preferably 150 parts by weight, further still more preferably 100 parts by weight based on 100 parts by weight of the white inorganic particles.

[0166] The heating temperature used in the drying and heating treatments is preferably 40 to 150°C, more preferably 60 to 120°C, and the heating time is preferably 10 minutes to 12 hours, more preferably 30 minutes to 3 hours.

[0167] The alkoxysilanes or fluoroalkylsilanes used as a gluing agent layer in the obtained composite particles are finally coated in the form of organosilane compounds produced from the alkoxysilanes or fluoroalkyl organosilane compounds obtainable from fluoroalkylsilanes through the above treatment steps.

[0168] The white inorganic particles may be previously coated, if required, with hydroxides and/or oxides of aluminum and/or silicon prior to mixing and stirring with the gluing agent.

[0169] The formation of the hydroxides and/or oxides of aluminum and/or silicon coat is conducted as follows. That is, an aluminum compound, a silicon compound or both the aluminum and silicon compounds are added to a water suspension prepared by dispersing the white inorganic particles in water. The resultant mixture is mixed and stirred together and then, if required, the pH value thereof is adjusted adequately, thereby forming the hydroxides and/or oxides of aluminum and/or silicon coat, on the surface of the white inorganic particle. Thereafter, the thus-obtained white inorganic particles coated with the hydroxides and/or oxides of aluminum and/or silicon are filtered out, washed with water, dried and then pulverized, and may be further subjected to subsequent treatments such as deaeration and compaction, if required.

[0170] Examples of the aluminum compound may include aluminum salts such as aluminum acetate, aluminum sulfate, aluminum chloride and aluminum nitrate, alkali aluminates such as sodium aluminate, or the like.

[0171] Examples of the silicon compound may include water glass #3, sodium orthosilicate, sodium metasilicate or the like.

[0172] The paint according to the present invention can be produced by blending the pigment according to the present invention and the above-mentioned paint base material in specific weight ratios by a commonly used mixer such as ball mill, roll mill, homomixer, shaker, attritor or sand grinder.

[0173] The rubber or resin composition according to the present invention may be produced by preliminarily intimately mixing a raw rubber or resin material and the black iron-based composite particles together and applying a strong shear force to the mixture by a kneader or an extruder to disaggregate agglomerates of the black iron-based composite particles and uniformly disperse the individual black iron-based composite particles in the rubber or resin. The thus produced rubber or resin composition may be formed into an appropriate shape according to the application thereof upon use.

[0174] The point of the present invention is that the composite particles comprising the white organic particles, the gluing agent coating layer formed on the surface of the white inorganic particle and the organic pigment coat formed on the gluing agent coating layer, are substantially free from the desorption of the organic pigment from the surface of the white inorganic particle, and contain no harmful elements.

[0175] The reason why the composite particles of the present invention can be inhibited from undergoing the desorption of the organic pigment from the surface of the white inorganic particle, is considered by the present inventors as follows.

[0176] That is, in the case where the alkoxysilanes are used, it is considered that metaloxane bonds (Si-O-M wherein M represents a metal element contained in the white inorganic particles) are formed between metal elements contained within or on the surfaces of the white inorganic particles and alkoxy groups contained in the alkoxysilanes or fluoroalkylsilanes, so that the organosilane compounds produced from the alkoxysilanes or fluoroalkyl organosilane compounds obtainable from fluoroalkylsilanes onto which the organic pigment coat is formed, can be strongly bonded to the surface of the white inorganic particles.

[0177] Also, in the case where the coupling agent is used, it is considered that since the coupling agent onto which the organic pigment coat is formed, contains reactive groups exhibiting a high reactivity with inorganic materials, the reactive groups can be strongly bonded to the surface of the white inorganic particles.

[0178] Further, in the case where polysiloxanes, oligomers or polymer compounds are used, it is considered that various functional groups of the polysiloxanes, oligomers or polymer compounds onto which the organic pigment coat is formed, can be strongly bonded to the surface of the white inorganic particles.

[0179] Another point of the present invention is that the paint blended with the composite particles of the present invention can exhibit excellent stability and dispersibility, and the resin composition blended with the composite particles of the present invention can exhibit an excellent dispersibility.

[0180] The reason why the paint of the present invention is excellent in stability and dispersibility, and the resin composition of the present invention is excellent in dispersibility, is considered by the present inventors as follows.

That is, the composite particles which are free from desorption of the organic pigment from the surfaces of the white inorganic particles, are used as a colorant for the paint and resin composition.

[0181] A still further point of the present invention is that the paint produced via the pigment dispersion of the present invention can show more excellent stability and dispersibility, and the resin composition produced via the master batch pellets of the present invention can show a more excellent dispersibility.

[0182] In addition, the composite particles of the present invention contain no harmful elements and compounds and, therefore, can provide a pigment which is excellent from viewpoints of not only hygiene and safety, but also environmental protection.

[0183] Thus, the composite particles of the present invention are substantially free from desorption of the organic pigment from the surfaces of the core particles and are harmless, and, therefore, are suitably used as a coloring pigment in various applications.

[0184] Also, in the paint and the resin composition of the present invention, the composite particles which are substantially free from desorption of the organic pigment therefrom and are harmless, are used as a coloring pigment therefor. Therefore, the paint and the resin composition of the present invention are free from environmental pollution.

EXAMPLES

[0185] The present invention will now be described in more detail with reference to the following examples, but the present invention is not restricted to those examples and various modifications are possible within the scope of the present invention.

[0186] Various properties were evaluated by the following methods.

(1) The average particle size of the particles was expressed by an average value of 350 particles observed on a micrograph.

(2) The specific surface area was expressed by the value measured by a BET method.

(3) The amounts of Al and Si which were present on the surface of white inorganic particle coated with an intermediate coating material, were respectively measured by a fluorescent X-ray spectroscopy device "3063 M-type" (manufactured by RIGAKU DENKI KOGYO CO., LTD.) according to JIS K0119 "General rule of fluorescent X-ray analysis".

In the case where the gluing agent-coated white inorganic particles were composed of silicon-free core particles and a silicon-containing gluing agent, the amount of Si was measured by a fluorescent X-ray spectroscopy device "3063 M-type" (manufactured by RIGAKU DENKI KOGYO CO., LTD.) according to JIS K0119 "General rule of fluorescent X-ray analysis" to determine the amount of the gluing agent coating layer formed on the surface of the white inorganic particles.

Also, in the case where the gluing agent-coated white inorganic particles were composed of silicon-containing core particles and a silicon-free gluing agent, the amount of C was measured by "Horiba Metal, Carbon and Sulfur Analyzer EMIA-2200 Model" (manufactured by HORIBA SEISAKUSHO CO., LTD.) to determine the amount of the gluing agent coating layer formed on the surface of the white inorganic particles.

(4) The amount of the organic pigment adhered onto the surface of the white inorganic particle was expressed by the amount of carbon measured by "Horiba Metal, Carbon and Sulfur Analyzer EMIA-2200 Model" (manufactured by HORIBA SEISAKUSHO CO., LTD.).

(5) The desorption percentage (%) of the organic pigment desorbed from the white inorganic particles was measured by the following method. The closer to 0% the desorption percentage, the smaller the amount of the organic pigment desorbed from the surfaces of the white inorganic particles.

That is, 2 g of the particles to be measured and 20 ml of dibromomethane were placed in a 50-ml conical flask and then were subjected to ultrasonic dispersion for 20 minutes. Thereafter, the obtained dispersion was allowed to stand for 3 days, and a supernatant containing the organic pigment desorbed was separated from the particles on the basis of the difference in specific gravity between the organic pigment and the particles. Next, the light transmittance of the obtained supernatant was measured by a self-recording photoelectric spectrophotometer "UV-2100" (manufactured by SHIMADZU SEISAKUSHO CO., LTD.). Using a calibration curve prepared on the basis of a concentration of organic pigment contained in dibromomethane and its light transmittance as previously calculated, the concentration of the desorbed organic pigment present in dibromomethane was calculated from the measured value, and further the desorption percentage (%) of the organic pigment was calculated according to the following formula:

Desorption percentage of

$$\text{organic pigment (\%)} = \{(W_a - W_e)/W_a\} \times 100$$

wherein W_a represents an amount of organic pigment initially adhered onto the surfaces of the white inorganic particles; and W_e represents an amount of organic pigment still adhered on the surfaces of the white inorganic particles after desorption test.

Separately, in the case where the specific gravity of the organic pigment was close to that of the composite particles, the degree of desorption of the organic pigment from the composite particles was visually observed and evaluated by the below-mentioned method, and the observation results were classified into the following five ranks. The rank 5 represents that the amount of the organic pigment desorbed from the composite particles is smallest.

2 g of the particles to be measured and 20 ml of ethanol were placed in a 50-ml conical flask and then was subjected to ultrasonic dispersion for 60 minutes. Thereafter, the obtained dispersion was centrifuged at a rotating speed of 10,000 rpm for 15 minutes to separate the particles from the solvent. The obtained particles were dried at 80°C for one hour, and the micrograph ($\times 50,000$) thereof was visually observed to count the number of the desorbed and re-aggregated organic pigment particles present in visual field of the micrograph. The micrograph was compared with a micrograph ($\times 50,000$) of mixed particles obtained by simply mixing the white inorganic particles with the organic pigment without forming a gluing agent coating layer. The results are classified into the following five ranks.

Rank 1: Number of desorbed and re-aggregated particles was substantially the same as that in the simply mixed particles;

Rank 2: 30 to 49 desorbed and re-aggregated particles per 100 white inorganic particles such as extender pigment were recognized;

Rank 3: 10 to 29 desorbed and re-aggregated particles per 100 white inorganic particles were recognized;

Rank 4: 5 to 9 desorbed and re-aggregated particles per 100 white inorganic particles were recognized; and

Rank 5: 0 to 4 desorbed and re-aggregated particles per 100 white inorganic particles were recognized.

(6) The hue of each of the white inorganic particles, organic pigment and composite particles, were measured by the following method.

That is, 0.5 g of each sample and 0.5 ml of castor oil were intimately kneaded together by a Hoover's muller to form a paste. 4.5 g of clear lacquer was added to the obtained paste and was intimately kneaded to form a paint. The obtained paint was applied on a cast-coated paper by using a 150 μm (6-mil) applicator to produce a coating film piece (having a film thickness of about 30 μm). The thus obtained coating film piece was measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.) and a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.) to determine L^* , a^* and b^* values thereof, respectively. Meanwhile, the C^* value representing chroma is calculated according to the following formula:

$$C^* = ((a^*)^2 + (b^*)^2)^{1/2}$$

(7) The tinging strength of the composite particles was measured by the following method.

[0187] That is, a primary color enamel and a vehicle enamel prepared by the below-mentioned method were respectively applied on a cast-coated paper by a 150 μm (6-mil) applicator to produce coating film pieces. The thus obtained coating film pieces were measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.) and a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.) to determine L^* values thereof. The difference between the obtained L^* values was represented by a ΔL^* value.

[0188] Next, as a standard sample for the composite particles, a mixed pigment was prepared by simply mixing the organic pigment and the white inorganic particles at the same mixing ratio as used for the production of the composite particles. Using the thus prepared mixed pigment as standard sample, the same procedure as defined above was conducted to prepare a primary color enamel and a vehicle enamel, form coating film pieces and measure L^* values thereof. The difference between the L^* values was represented by a ΔL_s^* value.

[0189] From the obtained ΔL^* value of the composite particles and ΔL_s^* value of the standard sample, the tinting

strength (%) was calculated according to the following formula:

$$\text{Tinting strength (\%)} = 100 + \{(\Delta L^* - \Delta L^*) \times 10\}$$

Preparation of primary color enamel:

[0190] 10 g of the above sample particles, 16 g of an amino alkyd resin and 6 g of a thinner were blended together. The resultant mixture was added together with 90 g of 3mmφ glass beads into a 140-ml glass bottle, and then mixed and dispersed for 45 minutes by a paint shaker. The obtained mixture was mixed with 50 g of an amino alkyd resin, and further dispersed for 5 minutes by a paint shaker, thereby obtaining a primary color enamel.

Preparation of vehicle enamel:

[0191] 12 g of the above-prepared primary color enamel and 40 g of Aramic White (titanium dioxide-dispersed amino alkyd resin) were blended together, and the resultant mixture was mixed and dispersed for 15 minutes by a paint shaker, thereby preparing a vehicle enamel.

(8) The hiding powers of the white inorganic particles, organic pigment and composite particles were measured by the cryptometer method according to JIS K5101-8.2 using the above-prepared primary color enamel.

(9) The light resistances of the white inorganic particles, organic pigment and composite particles were measured by the following method.

That is, the same primary color enamel as prepared above for the measurement of tinting strength, was applied onto a cold-rolled steel plate (0.8 mm × 70 mm × 150 mm; JIS G-3141) and dried to form a coating film having a thickness of 150 μm. One half of the thus prepared test specimen was covered with a metal foil, and an ultraviolet light was continuously irradiated over the test specimen at an intensity of 100 mW/cm² for 6 hours using "EYE SUPER UV TESTER SUV-W13" (manufactured by IWASAKI DENKI CO., LTD.). Then, the hues (L*, a* and b* values) of the metal foil-covered non-irradiated portion and the UV-irradiated portion of the test specimen were respectively measured. The ΔE* value was calculated from differences between the measured hue values of the metal foil-covered non-irradiated portion and the UV-irradiated portion according to the following formula:

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

wherein ΔL* represents the difference between L* values of the non-irradiated and UV-irradiated portions; Δa* represents the difference between a* values of the non-irradiated and UV-irradiated portions; and Δb* represents the difference between b* values of the non-irradiated and UV-irradiated portions.

(10) The average major diameter and average minor diameter (average diameter) of the master batch pellets were respectively expressed by average values obtained by measuring these parameters of 10 pellets using vernier calipers.

(11) The hues of the solvent-based paint and water-based paint using the composite particles were measured by the following method.

That is, the respective paints prepared by the below-mentioned methods, were applied onto a cold-rolled steel plate (0.8 mm × 70 mm × 150 mm; JIS G-3141) and dried to form a coating film having a thickness of 150 μm. The thus obtained test specimens were measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.) and a portable spectrocoulometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.) to determine L*, a* and b* values thereof. Also, the hue of the resin composition tinted with the composite particles was measured by the following method. That is, a colored resin plate prepared by the below-mentioned method was measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.) and a portable spectrocoulometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.) by the same method as described above.

(12) The gloss of the coating film was measured by irradiating light at an incident angle of 60°, using a gloss meter UGV-5D (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.). The higher the gloss,

the more excellent the dispersibility of the composite particles in the paint.

(13-1) The light resistances of coating films produced from the respective paints, were measured by the following method.

That is, one half of the same test specimen as prepared and used for measuring hues of the above paints, was covered with a metal foil, and an ultraviolet light was continuously irradiated over the test specimen at an intensity of 100 mW/cm² for 6 hours using "EYE SUPER UV TESTER SUV-W13" (manufactured by IWASAKI DENKI CO., LTD.). Then, the hues (L*, a* and b* values) of the metal foil-covered non-irradiated portion and the UV-irradiated portion of the test specimen were respectively measured. The ΔE^* value was calculated from differences between the measured hue values of the metal foil-covered non-irradiated portion and the UV-irradiated portion according to the above-described formula.

(13-2) The light resistances of the respective resin compositions, were measured by the following method.

That is, one half of the same resin plate as prepared and used for measuring hues of the above resin composition, was covered with a metal foil, and an ultraviolet light was continuously irradiated over the resin plate at an intensity of 100 mW/cm² for 6 hours using "EYE SUPER UV TESTER SUV-W13" (manufactured by IWASAKI DENKI CO., LTD.). Then, the hues (L*, a* and b* values) of the metal foil-covered non-irradiated portion and the UV-irradiated portion of the resin plate were respectively measured. The ΔE^* value was calculated from differences between the measured hue values of the metal foil-covered non-irradiated portion and the UV-irradiated portion according to the above-described formula.

(14) The transparency of the coating film using the composite particles was expressed by the linear absorption defined by the following formula. Specifically, the linear absorption was calculated from the light transmittance of a coating film produced by applying a paint prepared by the below-mentioned method on a 100 μ m-thick clear base film. The light transmittance was measured using a self-recording photoelectric spectrophotometer "UV-2100" (manufactured by SHIMADZU SEISAKUSHO CO., LTD.). Also, the transparency of the resin composition was expressed by the linear absorption of a resin plate having the following composition. The linear absorption was calculated from the light transmittance of the resin plate which was measured using a self-recording photoelectric spectrophotometer "UV-2100" (manufactured by Shimadzu Seisakusho CO., LTD.). The smaller the linear absorption, the higher the light transmittance and the higher the transparency.

$$\text{Linear absorption } (\mu\text{m}^{-1}) = \ln(1/t)/FT$$

wherein t is a light transmittance (-) at $\lambda = 900 \text{ nm}$; FT is a thickness (μm) of the coating film or resin plate to be tested.

Preparation of paint for evaluation of transparency:

[0192] 5 g of sample particles and the other components shown below were added at the following weight ratio into a 250-ml glass bottle, and then mixed and dispersed therein together with 160 g of 3mm ϕ glass beads for 120 minutes by a paint shaker, thereby preparing a paint for evaluation of transparency.

Composition of paint for evaluation of transparency:		
Sample particles		9.9 parts by weight
Melamine resin (SUPER PECKAMINE J-820-60 (tradename) produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)		19.8 parts by weight
Alkyd resin (BECKOZOL 1307-60EL (tradename) produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)		39.6 parts by weight
Xylene		29.7 parts by weight
Butanol		1.0 part by weight

Preparation of water-based paint for evaluation of transparency:

[0193] 5 g of sample particles and the other components shown below were added at the following weight ratio into a 250-ml glass bottle, and then mixed and dispersed therein together with 160 g of 3mm ϕ glass beads for 120 minutes by a paint shaker, thereby preparing a paint for evaluation of transparency.

Composition of paint for evaluation of transparency:		
Sample particles		10.1 parts by weight
5	Water-based melamine resin (S-695 (tradename) produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)	9.3 parts by weight
	Water-based alkyd resin (S-118 (tradename) produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)	40.7 parts by weight
10	Defoamer (NOPCO 8034 (tradename) produced by SUN NOPCO CO., LTD.)	0.2 part by weight
	Water	28.2 parts by weight
	Butyl cellosolve	11.5 parts by weight

Preparation of resin composition for evaluation of transparency:

[0194] 0.5 g of sample particles and 49.5 g of polyvinyl chloride resin particles ("103EP8D" (tradename), produced by NIPPON ZEON CO., LTD.) were weighed and charged into a 100 ml beaker made of a resin, and intimately mixed together by a spatula, thereby obtaining mixed particles.

[0195] 1.0 g of calcium stearate was added to the obtained mixed particles. The mixed particles were intimately mixed and then slowly supplied to hot rolls heated to 160°C whose clearance was set to 0.2 mm, and continuously kneaded therebetween until a uniform resin composition was produced. The resin composition kneaded was separated from the hot rolls and used as a raw material for forming a colored resin plate. Next, the thus-produced resin composition was interposed between a pair of surface-polished stainless steel plates, placed within a hot press heated to 180°C and then subjected to a pressure molding while applying a pressure of 9.8×10^7 Pa (1 ton/cm²) thereto, thereby obtaining a colored resin plate for evaluation of transparency, having a thickness of 1 mm.

(15) The storage stability of the paint was measured by the following method.

That is, the respective paints prepared by the below-mentioned method were applied onto a cold-rolled steel plate (0.8 mm × 70 mm × 150 mm; JIS G-3141) and dried to form a coating film having a thickness of 150 μm. Then, the L*, a* and b* values of the thus prepared coating film were measured. Separately, the respective paints were allowed to stand at 25°C for one week, and then applied onto the cold-rolled steel plate and dried to form a similar coating film. The L*, a* and b* values of the thus prepared coating film were also measured. The ΔE* value was calculated from the differences between the measured values according to the following formula:

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

wherein ΔL* represents the difference between L* values before and after the standing test; Δa* represents the difference between a* values before and after the standing test; and Δb* represents the difference between b* values before and after the standing test.

(16) The viscosity at 25°C of the paint prepared by the below-mentioned method, was measured at a shear rate (D) of 1.92 sec⁻¹ using an E-type viscometer (cone plate-type viscometer) EMD-R (manufactured by TOKYO KEIKI CO., LTD.).

(17) The dispersibility of the composite particles in resin composition was evaluated by visually counting the number of undispersed aggregate particles on a surface of the obtained resin plate, and classifying the results into the following five ranks. The rank 5 represents the most excellent dispersing condition.

- Rank 5: No undispersed aggregate particles were recognized.
- Rank 4: 1 to 4 undispersed aggregate particles per 1 cm² were recognized;
- Rank 3: 5 to 9 undispersed aggregate particles per 1 cm² were recognized;
- Rank 2: 10 to 49 undispersed aggregate particles per 1 cm² were recognized;
- Rank 1: Not less than 50 undispersed aggregate particles per 1 cm² were recognized.

Example 1:<Production of composite particles>

[0196] 20 kg of titanium oxide particles (particle shape: granular shape; average particle size: 0.24 μm ; BET specific surface area value: 11.6 m^2/g ; when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), L^* value: 94.15, a^* value: 1.06, b^* value: 2.22 and C^* value: 2.46, (when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), L^* value: 96.31, a^* value: 1.06, b^* value: -1.66 and C^* value: 1.97); hiding power: 1,490 cm^2/g ; light resistance (ΔE^* value): 6.86) were deaggregated in 150 liters of pure water using a stirrer, and further passed through a TK pipeline homomixer (manufactured by TOKUSHU KIKI KOGYO CO., LTD.) three times, thereby obtaining a slurry containing the titanium oxide particles.

[0197] Successively, the obtained slurry was passed through a transverse-type sand grinder (tradename "MIGHTY MILL MHG-1.5L", manufactured by INOUE SEISAKUSHO CO., LTD.) five times at an axis-rotating speed of 2,000 rpm, thereby obtaining a slurry in which the titanium oxide particles were dispersed.

[0198] The titanium oxide particles in the obtained slurry, which remained on a sieve of 325 meshes (mesh size: 44 μm) was 0 %. The slurry was filtered and washed with water, thereby obtaining a wet cake composed of the titanium oxide particles. The obtained wet cake composed of the titanium oxide particles was dried at 120°C. 11.0 kg of the dried particles were then charged into an edge runner "MPUV-2 Model" (tradename, manufactured by MATSUMOTO CHUZO TEKKOSHO CO., LTD.), and mixed and stirred at 294 N/cm (30 Kg/cm) for 30 minutes, thereby lightly deaggregating the particles.

[0199] Then, 110 g of methyltriethoxysilane "TSL8123" (tradename, produced by GE TOSHIBA SILICONE CO., LTD.) was mixed and diluted with 200 ml of ethanol to obtain a solution of methyltriethoxysilane. The methyltriethoxysilane solution was added to the deaggregated titanium oxide particles while operating the edge runner. The titanium oxide particles were continuously mixed and stirred at a linear load of 588 N/cm (60 Kg/cm) and a stirring speed of 22 rpm for 30 minutes.

[0200] Next, 1,100 g of organic pigment B-1 (kind: phthalocyanine-based pigment; particle shape: granular shape; average particle size: 0.06 μm ; BET specific surface area: 71.6 m^2/g ; hiding power: 240 cm^2/g ; when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), L^* value: 5.20, a^* value: 9.14, and b^* value: -21.84, (when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), L^* value: 17.70, a^* value: 9.72 and b^* value: -23.44); light resistance (ΔE^* value): 10.84), was added to the titanium oxide particles coated with methyltriethoxysilane for 10 minutes while operating the edge runner. Further, the particles were continuously mixed and stirred at a linear load of 392 N/cm (40 Kg/cm) and a stirring speed of 22 rpm for 20 minutes to form an organic pigment B-1 coat on the coating layer composed of methyltriethoxysilane. Then, the thus obtained coated particles were heat-treated at 105°C for 60 minutes by using a drier, thereby obtaining composite particles.

[0201] The resultant composite particles were granular particles having an average particle size of 0.24 μm . In addition, the composite particles showed a BET specific surface area value of 13.8 m^2/g , when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), L^* value of 64.33, a^* value of -5.68 and b^* value of -29.36, (when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), L^* value of 64.67, a^* value of 1.06 and b^* value of -31.42); tinting strength of 138%, hiding power of 1,520 cm^2/g , and light resistance (ΔE^* value) of 2.48. The desorption percentage of the organic pigment from the composite particles was 2.5%. The amount of a coating organosilane compound produced from methyl triethoxysilane was 0.15% by weight (calculated as Si). The amount of the organic pigment coat formed on the coating layer composed of the organosilane compound produced from methyl triethoxysilane is 6.04% by weight (calculated as C) based on the weight of the composite particles (corresponding to 10 parts by weight based on 100 parts by weight of the titanium oxide particles).

[0202] As a result of observing the micrograph, since no organic pigment B-1 was recognized from the micrograph, it was confirmed that a whole amount of the organic pigment B-1 used contributed to the formation of the organic pigment coat on the coating layer composed of the organosilane compound produced from methyl triethoxysilane.

Example 2:<Production of solvent-based paint containing composite particles>

[0203] 10 g of the composite particles produced in Example 1, were blended with an amino alkyd resin and a thinner at the following weight ratio, and charged into a 140-ml glass bottle together with 90 g of 3 mm ϕ glass beads. Next, the obtained mixture was mixed and dispersed for 90 minutes by a paint shaker, thereby preparing a mill base.

Composition of Mill Base:		
5	Composite particles	12.2 parts by weight
	Amino alkyd resin (AMILAC No. 1026, produced by KANSAI PAINT CO., LTD.)	19.5 parts by weight
	Thinner	7.3 parts by weight

[0204] The above-prepared mill base was blended with an amino alkyd resin at the following weight ratio, and the obtained mixture was further mixed and dispersed for 15 minutes by a paint shaker, thereby obtaining a solvent-based paint containing the composite particles.

Composition of paint:		
15	Mill base	39.0 parts by weight
	Amino alkyd resin (AMILAC No. 1026, produced by KANSAI PAINT CO., LTD.)	61.0 parts by weight

[0205] The thus obtained solvent-based paint exhibited a viscosity of 1,024 cP and a storage stability (ΔE^* value) of 0.83.

[0206] Next, the thus prepared solvent-based paint was applied onto a cold-rolled steel plate (0.8 mm \times 70 mm \times 150 mm; JIS G-3141) and dried to form a coating film having a thickness of 150 μ m. The obtained coating film showed a gloss of 91% and a light resistance (ΔE^* value) of 2.81. As to the hue of the coating film, when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), the L^* value thereof was 67.13, the a^* value thereof was -5.32 and the b^* value thereof was -28.64, and when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), the L^* value thereof was 67.41 the a^* value thereof was -5.32 and the b^* value thereof was -30.74.

Example 3:

<Production of water-based paint containing composite particles>

[0207] 7.62 g of the composite particles obtained in Example 1, were blended with a water-soluble alkyd resin and the like at the following weight ratio, and charged into a 140-ml glass bottle together with 90 g of 3 mm ϕ glass beads. Next, the obtained mixture was mixed and dispersed for 90 minutes by a paint shaker, thereby preparing a mill base.

Composition of Mill Base:		
35	Composite particles	12.4 parts by weight
	Water-soluble alkyd resin (tradename: "S-118", produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)	9.0 parts by weight
	Defoamer (tradename: "NOPCO 8034", produced by SUN NOPCO CO., LTD.)	0.1 part by weight
	Water	4.8 parts by weight
	Butyl cellosolve	4.1 parts by weight

[0208] The above-prepared mill base was blended with paint components shown below at the following weight ratio, and the obtained mixture was further mixed and dispersed for 15 minutes by a paint shaker, thereby obtaining a water-based paint.

Composition of paint:		
50	Mill base	30.4 parts by weight
	Water-soluble alkyd resin (tradename: S-118, produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)	46.2 parts by weight
	Water-soluble melamine resin (tradename: S-695, produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)	12.6 parts by weight
	Defoamer (tradename: "NOPCO 8034", produced by SUN NOPCO CO., LTD.)	0.1 part by weight
	Water	9.1 parts by weight
55	Butyl cellosolve	1.6 parts by weight

[0209] The thus obtained water-based paint exhibited a viscosity of 2,560 cP and a storage stability (ΔE^* value) of 0.86.

[0210] Next, the thus prepared water-based paint was applied onto a cold-rolled steel plate (0.8 mm \times 70 mm \times 150 mm; JIS G-3141) and dried to form a coating film having a thickness of 150 μ m. The obtained coating film showed a gloss of 88% and a light resistance (ΔE^* value) of 2.72. As to the hue of the coating film, when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), the L^* value thereof was 65.13, the a^* value thereof was -5.63 and the b^* value thereof was -29.26, and when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), the L^* value thereof was 65.44, the a^* value thereof was -5.63 and the b^* value thereof was -31.33.

Example 4:

<Production of resin composition>

[0211] 2.5 g of the composite particles obtained in Example 1, and 47.5 g of polyvinyl chloride resin particles 103EP8D (produced by NIPPON ZEON CO., LTD.) were weighed and charged into a 100-ml beaker made of resins, and intimately mixed together by a spatula, thereby obtaining mixed particles.

[0212] 0.5 g of calcium stearate was added to the obtained mixed particles. The mixed particles were intimately mixed and then slowly supplied to hot rolls heated to 160°C whose clearance was set to 0.2 mm, and continuously kneaded therebetween until a uniform resin composition was produced. The resin composition kneaded was separated from the hot rolls and used as a raw material for forming a colored resin plate.

[0213] Next, the thus-produced resin composition was interposed between a pair of surface-polished stainless steel plates, placed within a hot press heated to 180°C and then subjected to a pressure molding while applying a pressure of 98,000 kPa (1 ton/cm²) thereto, thereby obtaining a colored resin plate having a thickness of 1 mm. The thus-produced colored resin plate had a dispersing condition of rank 5 and a light resistance (ΔE^* value) of 2.95. As to the hue of the colored resin plate, when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), the L^* value thereof was 66.31, the a^* value thereof was -5.84 and the b^* value thereof was -28.65, and when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), the L^* value thereof was 66.60, the a^* value thereof was -5.84 and the b^* value thereof was -30.75.

Example 5:

[0214] 20 kg of titanium oxide particles (particle shape: granular shape; average particle size: 0.24 μ m; BET specific surface area value: 11.6 m²/g; when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), L^* value: 94.15, a^* value: 1.06, b^* value: 2.22 and C^* value: 2.46 (when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), L^* value: 96.31, a^* value: 1.06, b^* value: -1.66 and C^* value: 1.97); hiding power: 1,490 cm²/g; light resistance (ΔE^* value): 6.86) were deaggregated in 150 liters of pure water using a stirrer, and further passed through a TK pipeline homomixer (manufactured by TOKUSHU KIKI KOGYO CO., LTD.) three times, thereby obtaining a slurry containing the titanium oxide particles.

[0215] Successively, the obtained slurry was passed through a transverse-type sand grinder (tradename "MIGHTY MILL MHG-1.5L", manufactured by INOUE SEISAKUSHO CO., LTD.) five times at an axis-rotating speed of 2,000 rpm, thereby obtaining a slurry in which the titanium oxide particles were dispersed.

[0216] The titanium oxide particles in the obtained slurry, which remained on a sieve of 325 meshes (mesh size: 44 μ m) was 0 %. The slurry was filtered and washed with water, thereby obtaining a wet cake composed of the titanium oxide particles. The obtained wet cake composed of the titanium oxide particles was dried at 120°C. 11.0 kg of the dried particles were then charged into an edge runner "MPUV-2 Model" (tradename, manufactured by MATSUMOTO CHUZO TEKKOSHO CO., LTD.), and mixed and stirred at 294 N/cm (30 Kg/cm) for 30 minutes, thereby lightly deaggregating the particles.

[0217] Then, 110 g of methyltriethoxysilane "TSL8123" (tradename, produced by GE TOSHIBA SILICONE CO., LTD.) was mixed and diluted with 200 ml of ethanol to obtain a solution of methyltriethoxysilane. The methyltriethoxysilane solution was added to the deaggregated titanium oxide particles while operating the edge runner. The titanium oxide particles were continuously mixed and stirred at a linear load of 588 N/cm (60 Kg/cm) and a stirring speed of 22 rpm for 20 minutes.

[0218] Next, 2,200 g of organic pigment B-1 (kind: phthalocyanine-based pigment; particle shape: granular shape; average particle size: 0.06 μ m; BET specific surface area: 71.6 m²/g; hiding power: 240 cm²/g; when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), L^* value: 5.20,

a* value: 9.14, and b* value: -21.84, (when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), L* value: 17.70, a* value: 9.72 and b* value: -23.44); light resistance (ΔE^* value): 10.84), was added to the titanium oxide particles coated with methyltriethoxysilane for 20 minutes while operating the edge runner. Further, the particles were continuously mixed and stirred at a linear load of 392 N/cm (40 Kg/cm) and a stirring speed of 22 rpm for 60 minutes to form an organic pigment B-1 coat on the coating layer composed of methyltriethoxysilane.

[0219] In order to confirm the amount of the coating methyltriethoxysilane and the amount of the organic pigment B-1 coat, a part of the obtained primary composite particles was sampled and heat-treated at 105°C for 60 minutes by using a drier. The amount of the coating methyltriethoxysilane was 0.15% by weight (calculated as Si), and the amount of the organic pigment B-1 coat was 10.96% by weight (calculated as C) (corresponding to 20 parts by weight based on 100 parts by weight of the titanium oxide particles). As a result of observing the micrograph, since substantially no organic pigment B-1 was recognized from the micrograph, it was confirmed that a whole amount of the organic pigment B-1 used contributed to the formation of the organic pigment coat on the coating layer composed of the organosilane compound produced from methyltriethoxysilane.

[0220] Next, 220 g of dimethylpolysiloxane (tradename "TSF451", produced by GE TOSHIBA SILICONES CO., LTD.) was added to the above primary composite particles while operating the edge runner. Further, the resultant mixture was mixed and stirred at a linear load of 588 N/cm (60 Kg/cm) and a stirring speed of 22 rpm for 60 minutes, thereby obtaining the primary composite particles having a uniform coating layer composed of dimethylpolysiloxane thereon.

[0221] Next, 2,200 g of organic pigment B-2 (kind: phthalocyanine-based pigment; particle shape: granular shape; average particle size: 0.08 μm ; BET specific surface area value: 56.3 m^2/g ; hiding power: 272 cm^2/g ; when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), L* value: 6.00, a* value: -11.60 and b* value: -23.56, (when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), L* value: 17.32, a* value: -11.60 and b* value: -26.53); light resistance (ΔE^* value): 10.21) was added to the coated primary composite particles for 20 minutes while operating the edge runner. Further, the particles were continuously mixed and stirred at a linear load of 392 N/cm (40 Kg/cm) and a stirring speed of 22 rpm for 60 minutes to form an organic pigment B-2 coat on the organic pigment B-1 coat through the coating layer composed of dimethylpolysiloxane. Then, the thus obtained coated particles were heat-treated at 105°C for 60 minutes by using a drier, thereby obtaining composite particles.

[0222] The resultant composite particles were granular particles having an average particle size of 0.25 μm . In addition, the composite particles showed a BET specific surface area value of 11.8 m^2/g , when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), L* value of 62.14, a* value of 7.24 and b* value of -19.92, (when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), L* value of 62.67, a* value of 7.24 and b* value of -23.07); tinting strength of 217%, hiding power of 1,810 cm^2/g , and light resistance (ΔE^* value) of 2.36. The desorption percentage of the organic pigments from the composite particles was 6.2%. The amount of the coating dimethylpolysiloxane was 0.70% by weight (calculated as Si). The total amount of the organic pigment coats was 18.84% by weight (calculated as C) based on the weight of the composite particles (corresponding to 40 parts by weight based on 100 parts by weight of the titanium oxide particles).

[0223] As a result of observing the micrograph, since substantially no organic pigments B-2 were recognized from the micrograph, it was confirmed that a whole amount of the organic pigments used contributed to the formation of the organic pigment coats on the coating layer composed of methyl hydrogen polysiloxane.

Example 6

<Production of solvent-based paint containing composite particles>

[0224] 10 g of the composite particles produced in Example 5, were blended with an amino alkyd resin and a thinner at the following weight ratio, and charged into a 140-ml glass bottle together with 90 g of 3 mm ϕ glass beads. Next, the obtained mixture was mixed and dispersed for 90 minutes by a paint shaker, thereby preparing a mill base.

Composition of Mill Base:	
Composite particles	12.2 parts by weight
Amino alkyd resin (AMILAC No. 1026, produced by KANSAI PAINT CO., LTD.)	19.5 parts by weight
Thinner	7.3 parts by weight

[0225] The above-prepared mill base was blended with an amino alkyd resin at the following weight ratio, and the obtained mixture was further mixed and dispersed for 15 minutes by a paint shaker, thereby obtaining a solvent-based

paint containing the composite particles.

Composition of paint:		
5	Mill base	39.0 parts by weight
	Amino alkyd resin (AMILAC No. 1026, produced by KANSAI PAINT CO., LTD.)	61.0 parts by weight

[0226] The thus obtained solvent-based paint exhibited a viscosity of 1,280 cP and a storage stability (ΔE^* value) of 0.78.

[0227] Next, the thus prepared solvent-based paint was applied onto a cold-rolled steel plate (0.8 mm \times 70 mm \times 150 mm; JIS G-3141) and dried to form a coating film having a thickness of 150 μ m. The obtained coating film showed a gloss of 93% and a light resistance (ΔE^* value) of 2.68. As to the hue of the coating film, when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), the L^* value thereof was 64.51, the a^* value thereof was 6.60 and the b^* value thereof was -21.24, and when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), the L^* value thereof was 64.91, the a^* value thereof was 6.60 and the b^* value thereof was -24.32.

Example 7:

<Production of water-based paint containing composite particles>

[0228] 7.62 g of the composite particles obtained in Example 5, were blended with a water-soluble alkyd resin and the like at the following weight ratio, and charged into a 140-ml glass bottle together with 90 g of 3 mm ϕ glass beads. Next, the obtained mixture was mixed and dispersed for 90 minutes by a paint shaker, thereby preparing a mill base.

Composition of Mill Base:		
30	Composite particles	12.4 parts by weight
	Water-soluble alkyd resin (tradename: "S-118", produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)	9.0 parts by weight
	Defoamer (tradename: "NOPCO 8034", produced by SUN NOPCO CO., LTD.)	0.1 part by weight
	Water	4.8 parts by weight
	Butyl cellosolve	4.1 parts by weight

[0229] The above-prepared mill base was blended with paint components shown below at the following weight ratio, and the obtained mixture was further mixed and dispersed for 15 minutes by a paint shaker, thereby obtaining a water-based paint.

Composition of paint:		
40	Mill base	30.4 parts by weight
	Water-soluble alkyd resin (tradename: S-118, produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)	46.2 parts by weight
45	Water-soluble melamine resin (tradename: S-695, produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)	12.6 parts by weight
	Defoamer (tradename: "NOPCO 8034", produced by SUN NOPCO CO., LTD.)	0.1 part by weight
	Water	9.1 parts by weight
	Butyl cellosolve	1.6 parts by weight

[0230] The thus obtained water-based paint exhibited a viscosity of 2,840 cP and a storage stability (ΔE^* value) of 0.78.

[0231] Next, the thus prepared water-based paint was applied onto a cold-rolled steel plate (0.8 mm \times 70 mm \times 150 mm; JIS G-3141) and dried to form a coating film having a thickness of 150 μ m. The obtained coating film showed a gloss of 89% and a light resistance (ΔE^* value) of 2.56. As to the hue of the coating film, when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), the L^* value thereof was 64.56, the a^* value thereof was 6.12 and the b^* value thereof was -20.63; and when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), the L^*

value thereof was 64.96, the a^* value thereof was 6.12 and the b^* value thereof was -23.74.

Example 8:

<Production of resin composition>

[0232] 2.5 g of the composite particles obtained in Example 5, and 47.5 g of polyvinyl chloride resin particles 103EP8D (produced by NIPPON ZEON CO., LTD.) were weighed and charged into a 100-ml beaker made of resins, and intimately mixed together by a spatula, thereby obtaining mixed particles.

[0233] 0.5 g of calcium stearate was added to the obtained mixed particles. The mixed particles were intimately mixed and then slowly supplied to hot rolls heated to 160°C whose clearance was set to 0.2 mm, and continuously kneaded therebetween until a uniform resin composition was produced. The resin composition kneaded was separated from the hot rolls and used as a raw material for forming a colored resin plate.

[0234] Next, the thus-produced resin composition was interposed between a pair of surface-polished stainless steel plates, placed within a hot press heated to 180°C and then subjected to a pressure molding while applying a pressure of 98,000 kPa (1 ton/cm²) thereto, thereby obtaining a colored resin plate having a thickness of 1 mm. The thus-produced colored resin plate had a dispersing condition of rank 5 and a light resistance (ΔE^* value) of 2.82. As to the hue of the colored resin plate, when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK-CHEMIE JAPAN CO., LTD.), the L^* value thereof was 65.06, the a^* value thereof was 6.63 and the b^* value thereof was -21.24, and when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), the L^* value thereof was 65.44, the a^* value thereof was 6.63 and the b^* value thereof was -24.32.

Example 9:

<Production of solvent-based pigment dispersion>

[0235] The composite particles produced in Example 1 were blended with an amino alkyd resin and a thinner as a pigment dispersion base material at the following weight ratio. Next, the obtained mixture was dispersed using a sand grinder mill, thereby preparing a solvent-based pigment dispersion.

Composition of pigment dispersion:		
Composite particles		12.2 parts by weight
Amino alkyd resin (AMILAC No. 1026, produced by KANSAI PAINT CO., LTD.)		6.1 parts by weight
Thinner		12.2 parts by weight

<Production of solvent-based paint>

[0236] The above-prepared pigment dispersion was blended with an amino alkyd resin at the following weight ratio, and the obtained mixture was further mixed and dispersed for 15 minutes by a paint shaker, thereby obtaining a solvent-based paint containing the composite pigment.

Composition of paint:		
Solvent-based pigment dispersion		30.5 parts by weight
Amino alkyd resin (AMILAC No. 1026, produced by KANSAI PAINT CO., LTD.)		69.5 parts by weight

[0237] The thus obtained solvent-based paint exhibited a viscosity of 608 cP and a storage stability (ΔE^* value) of 0.84.

[0238] Next, the thus prepared solvent-based paint was applied onto a cold-rolled steel plate (0.8 mm × 70 mm × 150 mm; JIS G-3141) and dried to form a coating film having a thickness of 150 μm. The obtained coating film showed a gloss of 105% and a light resistance (ΔE^* value) of 2.65. As to the hue of the coating film, when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK-CHEMIE JAPAN CO., LTD.), the L^* value thereof was 67.72, the a^* value thereof was -5.36 and the b^* value thereof was -28.09, and when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), the L^* value thereof was 67.99, the a^* value thereof was -5.36 and the b^* value thereof was -30.22.

Example 10:<Production of water-based pigment dispersion>

[0239] The composite particles obtained in Example 1 were blended with a water-soluble alkyd resin and the like as a pigment dispersion base material at the following weight ratio. Next, the obtained mixture was dispersed by a sand grinder mill, thereby preparing a water-based pigment dispersion.

Composition of pigment dispersion:		
Composite particles		17.5 parts by weight
Water-soluble alkyd resin (tradename: "S-118", produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)		3.5 parts by weight
Defoamer (tradename: "NOPCO 8034", produced by SUN NOPCO CO., LTD.)		0.1 part by weight
Water		7.5 parts by weight
Butyl cellosolve		6.4 parts by weight

<Production of water-based paint>

[0240] The above-prepared pigment dispersion was blended with paint components shown below at the following weight ratio, and the obtained mixture was further mixed and dispersed for 15 minutes by a paint shaker, thereby obtaining a water-based paint.

Composition of paint:		
Water-based pigment dispersion		35.0 parts by weight
Water-soluble alkyd resin (tradename: S-118, produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)		30.0 parts by weight
Water-soluble melamine resin (tradename: S-695, produced by DAI-NIPPON INK KAGAKU KOGYO CO., LTD.)		10.8 parts by weight
Defoamer (tradename: "NOPCO 8034", produced by SUN NOPCO CO., LTD.)		0.1 part by weight
Water		24.1 parts by weight

[0241] The thus obtained water-based paint exhibited a viscosity of 1,291 cP and a storage stability (ΔE^* value) of 0.85.

[0242] Next, the thus prepared water-based paint was applied onto a cold-rolled steel plate (0.8 mm \times 70 mm \times 150 mm; JIS G-3141) and dried to form a coating film having a thickness of 150 μ m. The obtained coating film showed a gloss of 95% and a light resistance (ΔE^* value) of 2.61. As to the hue of the coating film, when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), the L^* value thereof was 65.45, the a^* value thereof was -5.59 the b^* value thereof was -29.38, and when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), the L^* value thereof was 65.76, the a^* value thereof was -5.59 and the b^* value thereof was -31.44.

Examples 11:<Production of master batch pellets>

[0243] 80.0 parts by weight of polyvinyl chloride resin particles 103EP8D (produced by NIPPON ZEON CO., LTD.) and 20.0 parts by weight of the composite particles obtained in Example 1 were kneaded at 160°C using a twin-screw extruder, extruded therefrom, and then cut into pellets, thereby obtaining cylindrical master batch pellets having an average minor diameter of 3 mm and an average diameter of 3 mm.

<Production of resin composition>

[0244] 25.0 parts by weight of the thus-obtained master batch pellets, 74.5 parts by weight of polyvinyl chloride resin particles 103EP8D (produced by NIPPON ZEON CO., LTD.) and 0.5 part by weight of calcium stearate were mixed together by a ribbon blender, thereby preparing a raw material for a colored resin plate.

[0245] Next, the thus-produced resin composition was interposed between a pair of surface-polished stainless steel plates, placed within a hot press heated to 180°C and then subjected to a pressure molding while applying a pressure of 98,000 kPa (1 ton/cm²) thereto, thereby obtaining a colored resin plate having a thickness of 1 mm. The thus-produced colored resin plate had a dispersing condition of rank 5 and a light resistance (ΔE^* value) of 2.84. As to the hue of the colored resin plate, when measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.), the L* value thereof was 66.51, the a* value thereof was -5.72 and the b* value thereof was -28.92, and when measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.), the L* value thereof was 66.80, the a* value thereof was -5.72 and the b* value thereof was -31.01.

Core particles 1 to 7:

[0246] White inorganic particles as core particles 1 to 7 having properties shown in Table 1 were prepared.

Core particles 8:

[0247] A slurry containing titanium oxide particles was obtained by dispersing 20 kg of titanium oxide particles (core particles 1) in 150 liters of water. The pH value of the thus obtained re-dispersed slurry containing the titanium oxide particles was adjusted to 10.5 by using an aqueous sodium hydroxide solution, and then the concentration of the solid content in the slurry was adjusted to 98 g/liter by adding water thereto. After 150 liters of the slurry was heated to 60°C, 5,444 ml of a 1.0 mol/liter sodium aluminate solution (corresponding to 1.0% by weight (calculated as Al) based on the weight of the titanium oxide particles) was added to the slurry. After allowing the obtained slurry to stand for 30 minutes, the pH value of the slurry was adjusted to 7.5 by using acetic acid. After further allowing the resultant slurry to stand for 30 minutes, the slurry was subjected to filtration, washing with water, drying and pulverization, thereby obtaining the titanium oxide particles whose surface was coated with hydroxides of aluminum.

[0248] The essential production conditions are shown in Table 2, and various properties of the obtained surface-treated titanium oxide particles are shown in Table 3.

Core particles 9 to 14:

[0249] The same procedure as defined for the production of the above core particles 8, was conducted except that the core particles 2 to 7 were respectively used instead of the core particles 1, and kinds and amounts of coating materials were changed variously, thereby obtaining white inorganic particles whose surface was coated with an intermediate coating layer.

[0250] The essential production conditions are shown in Table 2, and various properties of the obtained surface-treated white inorganic particles are shown in Table 3.

[0251] Meanwhile, in Tables, "A" and "S" as described in "kind of coating material used in surface-treating step" represent hydroxides of aluminum and oxides of silicon, respectively.

Organic pigments:

[0252] Organic pigments having properties as shown in Table 4 were prepared.

Examples 12 to 27 and Comparative Examples 1 to 5:

[0253] The same procedure as defined in Example 1 was conducted except that kinds of core particles, kinds and amounts of additives added in coating step with gluing agent, linear load and treating time for edge runner treatment used in the coating step with gluing agent, kinds and amounts of organic pigments adhered in organic pigment-adhering step, and linear load and treating time for edge runner treatment used in the organic pigment-adhering step, were changed variously, thereby obtaining organic and inorganic composite pigments.

[0254] The essential production conditions are shown in Table 5, and various properties of the obtained organic and inorganic composite pigments are shown in Table 6.

[0255] In Example 16, 100 g of the organic pigment R-1 was continuously added for 100 minutes.

[0256] In Example 17, the organic pigment Y-1 was added five times in an amount of 20 g each such that the total amount of the organic pigment Y-1 added was 100 g, and then the organic pigment Y-2 was added two times in an amount of 25 g each such that the total amount of the organic pigment Y-2 added was 50 g.

[0257] In Example 20, after 50 g of the organic pigment B-1 and 50 g of the organic pigment Y-1 were mixed together, 100 g of the resultant mixed pigment was continuously added for 200 minutes.

[0258] In Example 27, the organic pigment G-1 was added ten times in an amount of 15 g each such that the total amount of the organic pigment G-1 added was 150 g.

Primary composite particles 1 to 17:

[0259] The same procedure as defined in Example 5 was conducted except that kinds of core particles, kinds and amounts of additives added in coating step with gluing agent, linear load and treating time for edge runner treatment used in the coating step with gluing agent, kinds and amounts of organic pigments adhered in first colored adhesion layer-adhering step, and linear load and treating time for edge runner treatment used in the first colored adhesion layer-adhering step, were changed variously, thereby obtaining primary composite particles.

[0260] The essential production conditions are shown in Table 7.

[0261] In the primary pigment 2, the organic pigment Y-1 was added six times in an amount of 20 g each such that the total amount of the organic pigment Y-1 added was 120 g.

[0262] In the primary pigment 6, 150 g of the organic pigment Y-1 was continuously added for 150 minutes.

[0263] In the primary pigment 8, 100 g of the organic pigment R-1 was continuously added for 150 minutes.

[0264] In the primary pigment 10, the organic pigment Y-1 was added ten times in an amount of 15 g each such that the total amount of the organic pigment Y-1 added was 150 g.

Examples 28 to 55 and Comparative Examples 6 to 16:

[0265] The same procedure as defined in Example 5 was conducted except that kinds of primary composite particles, kinds and amounts of additives added in coating step with gluing agent, linear load and treating time for edge runner treatment used in the coating step with gluing agent, kinds and amounts of organic pigments adhered in second colored adhesion layer-adhering step, and linear load and treating time for edge runner treatment used in the second colored adhesion layer-adhering step, were changed variously, thereby obtaining composite particles.

[0266] The essential production conditions are shown in Tables 8 to 10, and various properties of the obtained composite particles are shown in Tables 11 to 13.

[0267] In Example 34, the organic pigment B-2 was added three times in an amount of 25 g each such that the total amount of the organic pigment B-2 added was 75 g.

[0268] In Example 38, 100 g of the organic pigment B-2 was continuously added for 100 minutes.

[0269] In Example 40, 100 g of the organic pigment R-2 was continuously added for 100 minutes.

[0270] In Example 43, the organic pigment B-1 was added six times in an amount of 20 g each such that the total amount of the organic pigment B-1 added was 120 g.

[0271] In Example 44, 150 g of the organic pigment Y-2 was continuously added for 150 minutes.

[0272] In Example 45, the organic pigment Y-1 was added four times in an amount of 20 g each such that the total amount of the organic pigment Y-1 added was 80 g.

[0273] In Example 48, 200 g of the organic pigment Y-2 was continuously added for 200 minutes.

Examples 56 to 99 and Comparative Examples 17 to 40:

[0274] The same procedure as defined in Example 2 was conducted except that kinds of composite particles were changed variously, thereby obtaining solvent-based paints.

[0275] Various properties of the obtained solvent-based paints and various properties of coating films obtained therefrom are shown in Tables 14 to 18.

Examples 100 to 133:

[0276] The same procedure as defined in Example 9 was conducted except that kinds of composite particles, and kinds and amounts of resins and solvents contained in pigment dispersion base material, were changed variously, thereby obtaining solvent-based pigment dispersions.

[0277] The essential production conditions are shown in Tables 19 and 20.

Examples 134 to 153:

[0278] The same procedure as defined in Example 9 was conducted except that kinds and amounts of solvent-based pigment dispersions, resins and solvents were changed variously, thereby obtaining solvent-based paints.

[0279] The essential production conditions are shown in Tables 21 and 22, and various properties of the obtained solvent-based paints and various properties of coating films obtained from the paints are shown in Tables 23 and 24.

Examples 154 to 197 and Comparative Examples 41 to 64:

[0280] The same procedure as defined in Example 3 was conducted except that kinds of composite particles were changed variously, thereby obtaining water-based paints.

[0281] Various properties of the obtained water-based paints and various properties of coating films obtained from the paints are shown in Tables 25 to 29.

Examples 198 to 235:

[0282] The same procedure as defined in Example 10 was conducted except that kinds of composite particles, and kinds and amounts of resins and solvents contained in water-based pigment dispersion base material, were changed variously, thereby obtaining water-based pigment dispersions.

[0283] The essential production conditions are shown in Tables 30 and 31.

Examples 236 to 255:

[0284] The same procedure as defined in Example 10 was conducted except that kinds and amounts of water-based pigment dispersions, resins and solvents were changed variously, thereby obtaining water-based paints.

[0285] The essential production conditions are shown in Tables 32 and 33, and various properties of the obtained water-based paints and various properties of coating films obtained from the paints are shown in Tables 34 and 35.

Examples 256 to 299 and Comparative Examples 65 to 88:

[0286] The same procedure as defined in Example 4 was conducted except that kinds of composite particles were changed variously, thereby obtaining resin compositions.

[0287] The essential production conditions and various properties of the obtained resin compositions are shown in Tables 36 to 40.

Examples 300 to 331:

[0288] The same procedure as defined in Example 11 was conducted except that kinds of composite particles and kinds and amounts of resins were changed variously, thereby obtaining master batch pellets.

[0289] The essential production conditions are shown in Tables 41 and 42.

Examples 332 to 351:

[0290] The same procedure as defined in Example 11 was conducted except that kinds of master batch pellets and kinds and amounts of resins were changed variously, thereby obtaining resin compositions.

[0291] The essential production conditions are shown in Table 43, and various properties of the obtained resin compositions are shown in Tables 44 and 45.

Table 1

Kind of core particles	Properties of white inorganic particles			
	Kind	Shape	Average particle size (μm)	BET specific surface area value (m^2/g)
Core particles 1	Titanium oxide	Granular	0.25	10.3
Core particles 2	Titanium oxide	Granular	0.008	59.3
Core particles 3	Zinc oxide	Granular	0.18	18.3
Core particles 4	Silica	Spherical	0.021	196.2
Core particles 5	Silica	Spherical	0.005	312.6
Core particles 6	Precipitated barium sulfate	Granular	0.059	21.3
Core particles 7	Pearl mica	Plate- shaped	8.23	5.8

Table 1 (continued)

Kind of core particles	Properties of white inorganic particles			
	Hue			
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)	C* value ¹⁾ (-)
Core particles 1	94.43	-0.58	3.25	3.30
Core particles 2	92.15	0.32	5.67	5.68
Core particles 3	88.83	-2.14	8.37	8.64
Core particles 4	91.06	0.11	4.62	4.62
Core particles 5	90.26	0.12	5.72	5.72
Core particles 6	89.80	0.31	5.43	5.44
Core particles 7	86.53	1.65	6.23	6.44

(Note) 1): Measured by a portable spectrophotometer
"COLOR-GUIDE 45/0" (manufactured by BYK
CHEMIE JAPAN CO., LTD.)

Table 1 (continued)

Kind of core particles	Properties of white inorganic particles			
	Hue			
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)	C* value ²⁾ (-)
Core particles 1	96.63	-0.58	-0.69	0.90
Core particles 2	94.43	0.32	1.26	1.30
Core particles 3	90.27	-2.14	4.13	4.65
Core particles 4	93.12	0.11	0.26	0.28
Core particles 5	92.16	0.12	1.31	1.32
Core particles 6	91.62	0.31	1.03	1.08
Core particles 7	87.71	1.65	2.12	2.69

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING
 MACHINES MANUFACTURING CO., LTD.)

Table 1 (continued)

Kind of core particles	Properties of white inorganic particles	
	Hiding power (cm ² /g)	Light resistance (ΔE^* value) (-)
Core particles 1	1,560	6.15
Core particles 2	320	7.31
Core particles 3	730	5.86
Core particles 4	6	5.21
Core particles 5	6	5.46
Core particles 6	13	5.92
Core particles 7	280	9.11

Table 2

Core particles	Kind of core particles	Surface-treating step		
		Additives		
		Kind	Calculated as	Amount (wt. %)
Core particles 8	Core particles 1	Sodium aluminate	Al	1.0
Core particles 9	Core particles 2	Water glass #3	SiO ₂	1.0
Core particles 10	Core particles 3	Sodium aluminate	Al	2.0
Core particles 11	Core particles 4	Sodium aluminate	Al	0.5
Core particles 12	Core particles 5	Aluminum sulfate	Al	2.0
Core particles 13	Core particles 6	Sodium aluminate Water glass #3	Al SiO ₂	2.0 0.5
Core particles 14	Core particles 7	Aluminum sulfate	Al	0.5

Table 2 (continued)

Core particles	Surface-treating step		
	Coating material		
	Kind	Calculated as	Amount (wt. %)
Core particles 8	A	Al	0.98
Core particles 9	S	SiO ₂	0.98
Core particles 10	A	Al	1.96
Core particles 11	A	Al	0.49
Core particles 12	A	Al	1.96
Core particles 13	A	Al	1.93
	S	SiO ₂	0.47
Core particles 14	A	Al	0.50

Table 3

Kind of core particles	Properties of surface-treated white inorganic particles	
	Average particle size (μm)	BET specific surface area value (m ² /g)
Core particles 8	0.25	12.1
Core particles 9	0.008	61.2
Core particles 10	0.18	18.6
Core particles 11	0.022	186.3
Core particles 12	0.005	296.4
Core particles 13	0.061	21.9
Core particles 14	8.23	5.6

Table 3 (continued)

Kind of core particles	Properties of surface-treated white inorganic particles			
	Hue			
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)	C* value ¹⁾ (-)
Core particles 8	94.31	-0.46	3.41	3.44
Core particles 9	91.90	0.56	5.93	5.96
Core particles 10	88.31	-1.86	9.36	9.54
Core particles 11	90.95	0.09	4.46	4.46
Core particles 12	90.11	0.11	5.84	5.84
Core particles 13	89.30	0.44	5.20	5.21
Core particles 14	86.71	1.46	5.89	6.07

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 3 (continued)

Kind of core particles	Properties of surface-treated white inorganic particles			
	Hue			
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)	C* value ²⁾ (-)
Core particles 8	96.49	-0.46	-0.54	0.71
Core particles 9	94.13	0.56	1.51	1.61
Core particles 10	89.69	-1.86	5.07	5.40
Core particles 11	92.99	0.09	0.11	0.14
Core particles 12	91.99	0.11	1.42	1.42
Core particles 13	91.03	0.44	0.81	0.92
Core particles 14	87.91	1.46	1.80	2.32

(Note) 2) Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 3 (continued)

Kind of core particles	Properties of surface-treated white inorganic particles	
	Hiding power (cm ² /g)	Light resistance (ΔE^* value) (-)
Core particles 8	1,480	5.86
Core particles 9	310	7.01
Core particles 10	710	5.12
Core particles 11	6	5.06
Core particles 12	6	5.13
Core particles 13	14	5.32
Core particles 14	260	8.71

Table 4

Organic pigment	Properties of organic pigment	
	Kind	
Organic pigment B-1	Pigment blue (phthalocyanine-based pigment)	
Organic pigment B-2	Pigment blue (phthalocyanine-based pigment)	
Organic pigment G-1	Pigment green (phthalocyanine-based pigment)	
Organic pigment R-1	Pigment red (quinacridone-based pigment)	
Organic pigment R-2	Pigment red (quinacridone-based pigment)	
Organic pigment R-3	Pigment red (azo-based pigment)	
Organic pigment Y-1	Pigment yellow (azo-based pigment)	
Organic pigment Y-2	Pigment yellow (azo-based pigment)	

Table 4 (continued)

Organic pigment	Properties of organic pigment			
	Particle shape	Average particle size (μm)	BET specific surface area value (m^2/g)	Hiding power (cm^2/g)
Organic pigment B-1	Granular	0.06	71.6	240
Organic pigment B-2	Granular	0.08	56.3	272
Organic pigment G-1	Granular	0.06	60.5	210
Organic pigment R-1	Granular	0.58	19.3	480
Organic pigment R-2	Granular	0.50	21.6	220
Organic pigment R-3	Granular	0.55	18.6	380
Organic pigment Y-1	Granular	0.73	10.5	320
Organic pigment Y-2	Granular	0.65	12.3	280

Table 4 (continued)

Organic pigment	Properties of organic pigment		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Organic pigment B-1	5.20	9.14	-21.84
Organic pigment B-2	6.00	11.60	-23.56
Organic pigment G-1	12.29	-18.31	-3.40
Organic pigment R-1	32.77	51.88	25.80
Organic pigment R-2	21.03	58.26	26.02
Organic pigment R-3	35.18	49.18	25.14
Organic pigment Y-1	66.51	0.78	79.25
Organic pigment Y-2	68.30	0.65	80.99

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN
 CO., LTD.)

Table 4 (continued)

Organic pigment	Properties of organic pigment			
	Hue			Light resistance (ΔE^* value) (-)
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)	
Organic pigment B-1	17.70	9.72	-23.44	10.84
Organic pigment B-2	17.32	11.60	-26.53	10.21
Organic pigment G-1	21.83	-18.31	-7.36	9.63
Organic pigment R-1	36.99	51.88	20.57	14.65
Organic pigment R-2	28.30	58.26	20.61	16.36
Organic pigment R-3	39.31	49.18	19.77	18.60
Organic pigment Y-1	66.80	0.78	70.92	17.33
Organic pigment Y-2	68.58	0.65	72.86	19.65

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 5

Examples and Comparative Examples	Kind of core particles
Example 12	Core particles 1
Example 13	Core particles 2
Example 14	Core particles 3
Example 15	Core particles 4
Example 16	Core particles 5
Example 17	Core particles 6
Example 18	Core particles 7
Example 19	Core particles 8
Example 20	Core particles 9
Example 21	Core particles 10
Example 22	Core particles 11
Example 23	Core particles 12
Example 24	Core particles 13
Example 25	Core particles 14
Example 26	Core particles 1
Example 27	Core particles 6
Comparative Example 1	Core particles 1
Comparative Example 2	Core particles 1
Comparative Example 3	Core particles 1
Comparative Example 4	Core particles 1
Comparative Example 5	Core particles 4

Table 5 (continued)

Examples and Comparative Examples	Production of composite particles	
	Coating step with gluing agent	
	Additives	
	Kind	Amount added (wt. part)
Example 12	Methyl triethoxysilane	0.5
Example 13	Isopropyltriisostearoyl titanate	1.0
Example 14	Methyl triethoxysilane	1.0
Example 15	Methyl triethoxysilane	2.0
Example 16	Methyl hydrogen polysiloxane	2.0
Example 17	Dimethyl dimethoxysilane	4.0
Example 18	Phenyl triethoxysilane	1.0
Example 19	Methyl trimethoxysilane	2.0
Example 20	Polyvinyl alcohol	1.0
Example 21	Methyl trimethoxysilane	1.0
Example 22	γ -aminopropyl triethoxysilane	5.0
Example 23	Polyvinyl alcohol	1.0
Example 24	γ -aminopropyl triethoxysilane	2.0
Example 25	Methyl hydrogen polysiloxane	0.5
Example 26	γ -aminopropyl triethoxysilane	1.0
Example 27	Methyl hydrogen polysiloxane	1.0
Comparative Example 1	-	-
Comparative Example 2	Methyl triethoxysilane	1.0
Comparative Example 3	Methyl triethoxysilane	0.005
Comparative Example 4	Methyl triethoxysilane	1.0
Comparative Example 5	Methyl triethoxysilane	1.0

Table 5 (continued)

Examples and Comparative Examples	Production of composite particles				
	Coating step with gluing agent				
	Edge runner treatment			Coating amount	
	Linear load		Time (min.)	Calcu- lated as Si (wt.%)	Calcu- lated as C (wt.%)
	(N/cm)	(Kg/cm)			
Example 12	588	60	20	0.08	-
Example 13	294	30	30	-	0.74
Example 14	588	60	20	0.15	-
Example 15	588	60	30	-	0.13
Example 16	588	60	20	-	0.53
Example 17	735	75	20	0.89	-
Example 18	441	45	30	0.14	-
Example 19	588	60	20	0.40	-
Example 20	294	30	30	-	0.54
Example 21	588	60	20	0.20	-
Example 22	735	75	30	-	0.77
Example 23	588	60	30	-	0.54
Example 24	588	60	30	0.25	-
Example 25	441	45	30	0.21	-
Example 26	588	60	20	0.12	-
Example 27	588	60	30	0.42	-
Comparative Example 1	-	-	-	-	-
Comparative Example 2	588	60	20	0.15	-
Comparative Example 3	588	60	20	6×10^{-4}	-
Comparative Example 4	588	60	20	0.15	-
Comparative Example 5	588	60	30	-	4×10^{-3}

Table 5 (continued)

Examples and Comparative Examples	Production of composite particles			
	Adhesion step with organic pigment			
	Organic pigment			
	Kind	Amount adhered (wt. part)	Kind	Amount adhered (wt. part)
Example 12	R-1	10.0	-	-
Example 13	R-1	50.0	Y-1	30.0
Example 14	B-1	5.0	-	-
Example 15	B-1	50.0	-	-
Example 16	R-1	100.0	-	-
Example 17	Y-1	100.0	Y-2	50.0
Example 18	Y-1	10.0	-	-
Example 19	R-1	30.0	-	-
Example 20	B-1	50.0	Y-1	50.0
Example 21	B-1	30.0	-	-
Example 22	B-1	100.0	-	-
Example 23	R-1	40.0	B-1	20.0
Example 24	G-1	50.0	-	-
Example 25	Y-1	10.0	-	-
Example 26	B-1	10.0	-	-
Example 27	G-1	150.0	-	-
Comparative Example 1	B-1	10.0	-	-
Comparative Example 2	-	-	-	-
Comparative Example 3	B-1	10.0	-	-
Comparative Example 4	B-1	0.1	-	-
Comparative Example 5	B-1	750.0	-	-

Table 5 (continued)

Examples and Comparative Examples	Production of composite particles			
	Adhesion step with organic pigment			
	Edge runner treatment			Amount adhered (calculated as C) (wt. %)
	Linear load		Time (min.)	
(N/cm)	(Kg/cm)			
Example 12	588	60	20	6.96
Example 13	441	45	75	30.66
Example 14	588	60	30	3.12
Example 15	588	60	60	22.14
Example 16	441	45	90	38.41
Example 17	735	75	240	33.88
Example 18	588	60	20	4.80
Example 19	588	60	20	17.71
Example 20	588	60	90	30.74
Example 21	735	75	20	15.33
Example 22	735	75	90	33.19
Example 23	588	60	60	27.37
Example 24	588	60	60	11.97
Example 25	588	60	20	4.82
Example 26	588	60	300	5.98
Example 27	588	60	210	21.65
Comparative Example 1	588	60	20	5.98
Comparative Example 2	-	-	-	-
Comparative Example 3	588	60	20	6.00
Comparative Example 4	588	60	20	0.06
Comparative Example 5	588	60	30	58.53

Table 6

Examples and Comparative Examples	Properties of composite particles	
	Average particle size (μm)	BET specific surface area value (m^2/g)
Example 12	0.25	15.6
Example 13	0.010	56.1
Example 14	0.18	18.6
Example 15	0.023	121.2
Example 16	0.009	243.2
Example 17	0.066	15.3
Example 18	8.23	13.2
Example 19	0.26	18.3
Example 20	0.010	53.8
Example 21	0.19	21.2
Example 22	0.026	115.4
Example 23	0.008	241.2
Example 24	0.063	20.7
Example 25	8.23	13.6
Example 26	0.25	12.6
Example 27	0.067	24.1
Comparative Example 1	0.25	16.5
Comparative Example 2	0.25	10.1
Comparative Example 3	0.25	15.9
Comparative Example 4	0.25	12.1
Comparative Example 5	0.033	81.6

Table 6 (continued)

Examples and Comparative Examples	Properties of composite particles		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 12	54.65	47.89	-0.06
Example 13	51.64	31.26	25.78
Example 14	64.62	-6.42	-29.62
Example 15	11.58	8.60	-18.04
Example 16	55.57	48.32	23.96
Example 17	80.08	2.13	76.21
Example 18	81.06	1.36	87.56
Example 19	44.28	54.22	6.85
Example 20	33.97	-18.59	-6.85
Example 21	31.63	-7.64	-31.96
Example 22	10.59	8.80	-18.59
Example 23	51.78	38.83	-0.11
Example 24	16.84	-15.82	-11.84
Example 25	81.32	1.16	86.32
Example 26	11.57	2.13	-10.49
Example 27	14.63	-14.34	-10.82
Comparative Example 1	56.52	-2.68	-24.65
Comparative Example 2	91.32	-0.32	2.86
Comparative Example 3	55.33	-2.56	-25.12
Comparative Example 4	73.26	-0.14	-3.84
Comparative Example 5	7.07	9.46	-19.88

(Note) 1): Measured by a portable spectrophotometer
"COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
JAPAN CO., LTD.)

Table 6 (continued)

Examples and Comparative Examples	Properties of composite particles		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 12	55.54	47.89	-3.81
Example 13	53.14	31.26	20.38
Example 14	64.95	-6.42	-31.67
Example 15	21.32	8.60	-21.28
Example 16	56.63	48.32	18.65
Example 17	80.66	2.13	68.32
Example 18	81.76	1.36	78.75
Example 19	46.39	54.22	2.70
Example 20	38.34	-18.59	-10.64
Example 21	36.10	-7.64	-33.87
Example 22	20.60	8.80	-21.80
Example 23	53.26	38.83	-4.23
Example 24	25.29	-15.82	-15.39
Example 25	82.04	1.16	77.58
Example 26	21.31	2.13	-14.10
Example 27	23.78	-14.34	-14.42
Comparative Example 1	59.26	-2.68	-26.98
Comparative Example 2	93.08	-0.32	-1.06
Comparative Example 3	56.16	-2.56	-27.43
Comparative Example 4	73.58	-0.14	-7.37
Comparative Example 5	18.08	9.46	-23.03

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 6 (continued)

Examples and Comparative Examples	Properties of composite particles	
	Tinting strength (%)	Hiding power (cm ² /g)
Example 12	164	1,520
Example 13	208	490
Example 14	138	760
Example 15	138	520
Example 16	173	500
Example 17	158	480
Example 18	129	320
Example 19	193	1,490
Example 20	200	510
Example 21	216	730
Example 22	164	560
Example 23	163	480
Example 24	146	460
Example 25	132	360
Example 26	150	1,540
Example 27	176	560
Comparative Example 1	100	1,430
Comparative Example 2	-	1,480
Comparative Example 3	109	1,460
Comparative Example 4	-	1,470
Comparative Example 5	208	620

Table 6 (continued)

Examples and Comparative Examples	Properties of composite particles		
	Light resistance (ΔE^* value) (-)	Desorption percentage of organic pigment (%)	Degree of desorption of organic pigment (-)
Example 12	2.43	4.3	-
Example 13	2.24	6.8	-
Example 14	2.13	2.1	-
Example 15	1.23	-	5
Example 16	1.36	-	4
Example 17	2.17	7.5	-
Example 18	2.96	4.6	-
Example 19	1.74	2.6	-
Example 20	1.94	8.3	-
Example 21	1.25	0.8	-
Example 22	1.03	-	4
Example 23	1.30	-	5
Example 24	2.05	4.5	-
Example 25	2.59	0.6	-
Example 26	2.31	4.4	-
Example 27	1.98	8.8	-
Comparative Example 1	6.86	83.2	-
Comparative Example 2	6.20	-	-
Comparative Example 3	6.53	78.2	-
Comparative Example 4	6.48	-	-
Comparative Example 5	6.7	-	2

Table 7

Primary composite particles	Kind of core particles	Production of primary composite particles	
		Coating step with gluing agent	
		Additives	
		Kind	Amount added (wt. part)
Primary composite particles 1	Core particles 1	Methyl triethoxysilane	2.0
Primary composite particles 2	Core particles 2	Isopropyltriisostearoyl titanate	1.0
Primary composite particles 3	Core particles 3	Methyl trimethoxysilane	4.0
Primary composite particles 4	Core particles 4	Methyl hydrogen polysiloxane	5.0
Primary composite particles 5	Core particles 5	γ -aminopropyl triethoxysilane	0.5
Primary composite particles 6	Core particles 6	Phenyl triethoxysilane	1.5
Primary composite particles 7	Core particles 7	Methyl hydrogen polysiloxane	1.0
Primary composite particles 8	Core particles 8	Methyl triethoxysilane	3.0
Primary composite particles 9	Core particles 9	Polyvinyl alcohol	1.0
Primary composite particles 10	Core particles 10	Methyl trimethoxysilane	1.5
Primary composite particles 11	Core particles 11	Methyl triethoxysilane	1.5
Primary composite particles 12	Core particles 12	Polyvinyl alcohol	1.0
Primary composite particles 13	Core particles 13	γ -aminopropyl triethoxysilane	0.5
Primary composite particles 14	Core particles 14	Methyl hydrogen polysiloxane	2.0
Primary composite particles 15	Core particles 1	-	-
Primary composite particles 16	Core particles 1	Methyl triethoxysilane	0.005
Primary composite particles 17	Core particles 1	Methyl triethoxysilane	1.0

Table 7 (continued)

Primary composite particles	Production of primary composite particles				
	Coating step with gluing agent				
	Edge runner treatment			Coating amount	
	Linear load		Time (min.)	Calculated as Si (wt.%)	Calculated as C (wt.%)
	(N/cm)	(Kg/cm)			
Primary composite particles 1	392	40	20	0.30	-
Primary composite particles 2	588	60	30	-	0.74
Primary composite particles 3	392	40	30	0.79	-
Primary composite particles 4	588	60	20	-	1.30
Primary composite particles 5	588	60	30	-	0.08
Primary composite particles 6	588	60	20	0.20	-
Primary composite particles 7	392	40	40	0.42	-
Primary composite particles 8	784	80	50	0.45	-
Primary composite particles 9	588	60	30	-	0.54
Primary composite particles 10	588	60	60	0.30	-
Primary composite particles 11	588	60	30	-	0.10
Primary composite particles 12	588	60	60	-	0.54
Primary composite particles 13	588	60	30	0.06	-
Primary composite particles 14	588	60	40	0.83	-
Primary composite particles 15	-	-	-	-	-
Primary composite particles 16	588	60	30	6×10^{-4}	-
Primary composite particles 17	588	60	30	0.15	-

Table 7 (continued)

Primary composite particles	Production of primary composite particles	
	Adhesion step with first colored adhesion layer	
	Organic pigment	
	Kind	Amount adhered (wt. part)
Primary composite particles 1	B-1	20.0
Primary composite particles 2	Y-1	120.0
Primary composite particles 3	R-1	40.0
Primary composite particles 4	B-1	100.0
Primary composite particles 5	R-1	50.0
Primary composite particles 6	Y-1	150.0
Primary composite particles 7	B-1	80.0
Primary composite particles 8	R-1	100.0
Primary composite particles 9	G-1	50.0
Primary composite particles 10	Y-1	150.0
Primary composite particles 11	B-1	50.0
Primary composite particles 12	Y-1	100.0
Primary composite particles 13	R-3	30.0
Primary composite particles 14	Y-1	50.0
Primary composite particles 15	Y-1	10.0
Primary composite particles 16	Y-1	10.0
Primary composite particles 17	Y-1	0.1

Table 7 (continued)

Primary composite particles	Production of primary composite particles			
	Adhesion step with first colored adhesion layer			
	Edge runner treatment			Amount adhered (calculated as C) (wt. %)
	Linear load		Time (min.)	
	(N/cm)	(Kg/cm)		
Primary composite particles 1	588	60	60	11.04
Primary composite particles 2	588	60	180	30.81
Primary composite particles 3	784	80	60	21.89
Primary composite particles 4	588	60	120	33.15
Primary composite particles 5	392	40	60	25.54
Primary composite particles 6	588	60	120	33.89
Primary composite particles 7	784	80	180	29.43
Primary composite particles 8	588	60	360	38.26
Primary composite particles 9	490	50	120	11.93
Primary composite particles 10	588	60	300	31.88
Primary composite particles 11	588	60	30	22.06
Primary composite particles 12	294	30	60	28.29
Primary composite particles 13	588	60	60	13.37
Primary composite particles 14	784	80	90	17.62
Primary composite particles 15	588	60	60	4.71
Primary composite particles 16	588	60	60	4.73
Primary composite particles 17	588	60	60	0.04

Table 8

Examples	Kind of primary composite particles	Production of composite particles	
		Coating step with gluing agent	
		Additives	
		Kind	Amount added (wt. part)
Example 28	Primary composite particles 1	Methyl triethoxysilane	3.0
Example 29	Primary composite particles 2	Isopropyltriisostearoyl titanate	1.0
Example 30	Primary composite particles 3	Methyl trimethoxysilane	5.0
Example 31	Primary composite particles 4	Methyl triethoxysilane	2.0
Example 32	Primary composite particles 5	Methyl hydrogen polysiloxane	1.0
Example 33	Primary composite particles 6	Polyvinyl alcohol	3.0
Example 34	Primary composite particles 7	Methyl hydrogen polysiloxane	2.0
Example 35	Primary composite particles 8	Methyl triethoxysilane	3.5
Example 36	Primary composite particles 9	Methyl triethoxysilane	1.5
Example 37	Primary composite particles 10	Methyl trimethoxysilane	1.0
Example 38	Primary composite particles 11	Methyl triethoxysilane	0.5
Example 39	Primary composite particles 12	γ -aminopropyl triethoxysilane	0.5
Example 40	Primary composite particles 13	Dimethyl dimethoxysilane	1.0
Example 41	Primary composite particles 14	Methyl hydrogen polysiloxane	1.0

Table 8 (continued)

Examples	Production of composite particles				
	Coating step with gluing agent				
	Edge runner treatment			Coating amount	
	Linear load		Time (min.)	Calculated as Si (wt.%)	Calculated as C (wt.%)
	(N/cm)	(Kg/cm)			
Example 28	588	60	30	0.45	-
Example 29	588	60	30	-	0.74
Example 30	294	30	20	0.97	-
Example 31	441	45	60	-	0.13
Example 32	588	60	30	-	0.26
Example 33	294	30	60	-	1.55
Example 34	784	80	20	0.82	-
Example 35	735	75	20	0.52	-
Example 36	588	60	30	0.23	-
Example 37	588	60	30	0.20	-
Example 38	294	30	60	-	0.03
Example 39	392	40	60	-	0.08
Example 40	490	50	30	0.23	-
Example 41	441	45	30	0.42	-

Table 8 (continued)

Examples	Production of composite particles	
	Adhering step with second colored adhesion layer	
	Organic pigment	
	Kind	Amount adhered (wt. part)
Example 28	B-2	50.0
Example 29	Y-2	30.0
Example 30	R-2	25.0
Example 31	B-2	50.0
Example 32	R-2	50.0
Example 33	Y-2	50.0
Example 34	B-2	75.0
Example 35	R-2	40.0
Example 36	G-1	25.0
Example 37	Y-2	60.0
Example 38	B-2	100.0
Example 39	Y-2	80.0
Example 40	R-2	100.0
Example 41	Y-2	80.0

Table 8 (continued)

Examples	Production of composite particles			
	Adhering step with second colored adhesion layer			
	Edge runner treatment			Amount adhered (calculated as C) (wt. %)
	Linear load		Time (min.)	
(N/cm)	(Kg/cm)			
Example 28	588	60	120	22.14
Example 29	588	60	120	12.96
Example 30	392	40	60	15.25
Example 31	735	75	180	22.13
Example 32	588	60	180	25.48
Example 33	588	60	60	18.77
Example 34	588	60	150	28.49
Example 35	294	30	60	21.87
Example 36	441	45	60	7.09
Example 37	441	45	60	19.97
Example 38	588	60	120	33.21
Example 39	588	60	120	25.00
Example 40	588	60	60	38.33
Example 41	735	75	60	23.60

Table 9

Examples	Kind of primary composite particles	Production of composite particles	
		Coating step with gluing agent	
		Additives	
		Kind	Amount added (wt. part)
Example 42	Primary composite particles 1	Methyl triethoxysilane	5.0
Example 43	Primary composite particles 2	Isopropyltriisostearoyl titanate	2.0
Example 44	Primary composite particles 3	Methyl trimethoxysilane	3.0
Example 45	Primary composite particles 4	Methyl hydrogen polysiloxane	1.0
Example 46	Primary composite particles 5	Methyl triethoxysilane	3.0
Example 47	Primary composite particles 6	Polyvinyl alcohol	2.0
Example 48	Primary composite particles 7	Methyl hydrogen polysiloxane	0.5
Example 49	Primary composite particles 8	Methyl triethoxysilane	3.0
Example 50	Primary composite particles 9	Methyl triethoxysilane	1.5
Example 51	Primary composite particles 10	Methyl trimethoxysilane	10.0
Example 52	Primary composite particles 11	Methyl triethoxysilane	1.0
Example 53	Primary composite particles 12	γ -aminopropyl triethoxysilane	0.5
Example 54	Primary composite particles 13	Phenyl triethoxysilane	2.0
Example 55	Primary composite particles 14	Methyl hydrogen polysiloxane	1.0

Table 9 (continued)

Examples	Production of composite particles				
	Coating step with gluing agent				
	Edge runner treatment			Coating amount	
	Linear load		Time (min.)	Calculated as Si (wt.%)	Calculated as C (wt.%)
	(N/cm)	(Kg/cm)			
Example 42	588	60	20	0.72	-
Example 43	588	60	30	-	1.43
Example 44	735	75	30	0.59	-
Example 45	588	60	20	-	0.27
Example 46	392	40	30	-	0.19
Example 47	392	40	60		1.06
Example 48	588	60	30	0.21	-
Example 49	294	30	20	0.45	-
Example 50	588	60	30	0.23	-
Example 51	441	45	30	1.87	-
Example 52	392	40	30	-	0.06
Example 53	735	75	20	-	0.08
Example 54	588	60	30	0.27	-
Example 55	588	60	30	0.42	-

Table 9 (continued)

Examples	Production of composite particles	
	Adhering step with second colored adhesion layer	
	Organic pigment	
	Kind	Amount adhered (wt. part)
Example 42	R-2	60.0
Example 43	B-1	120.0
Example 44	Y-2	150.0
Example 45	Y-1	80.0
Example 46	B-2	10.0
Example 47	B-2	60.0
Example 48	Y-2	200.0
Example 49	B-2	80.0
Example 50	Y-1	70.0
Example 51	R-2	40.0
Example 52	Y-2	50.0
Example 53	R-1	20.0
Example 54	B-1	20.0
Example 55	B-2	15.0

Table 9 (continued)

Examples	Production of composite particles			
	Adhering step with second colored adhesion layer			
	Edge runner treatment			Amount adhered (calculated as C) (wt. %)
	Linear load		Time (min.)	
(N/cm)	(Kg/cm)			
Example 42	784	80	40	28.72
Example 43	588	60	120	36.31
Example 44	637	65	360	31.93
Example 45	392	40	360	25.03
Example 46	588	60	60	5.89
Example 47	588	60	120	24.92
Example 48	392	40	360	35.45
Example 49	539	55	80	29.56
Example 50	735	75	180	23.19
Example 51	588	60	60	21.85
Example 52	588	60	180	18.86
Example 53	441	45	120	12.71
Example 54	490	50	60	11.04
Example 55	392	40	20	8.64

Table 10

Comparative Examples	Kind of primary composite particles	Production of composite particles	
		Coating step with gluing agent	
		Additives	
		Kind	Amount added (wt. part)
Comparative Example 6	Primary composite particles 15	Methyl triethoxysilane	1.0
Comparative Example 7	Primary composite particles 16	Methyl triethoxysilane	1.0
Comparative Example 8	Primary composite particles 17	Methyl triethoxysilane	1.0
Comparative Example 9	Primary composite particles 1	-	-
Comparative Example 10	Primary composite particles 1	Methyl triethoxysilane	0.005
Comparative Example 11	Primary composite particles 15	Methyl triethoxysilane	1.0
Comparative Example 12	Primary composite particles 16	Methyl triethoxysilane	1.0
Comparative Example 13	Primary composite particles 17	Methyl triethoxysilane	1.0
Comparative Example 14	Primary composite particles 1	-	-
Comparative Example 15	Primary composite particles 1	Methyl triethoxysilane	0.005
Comparative Example 16	Primary composite particles 1	Methyl triethoxysilane	2.0

Table 10 (continued)

Comparative Examples	Production of composite particles			
	Coating step with gluing agent			
	Edge runner treatment			Coating amount
	Linear load		Time (min.)	Calculated as Si (wt. %)
	(N/cm)	(Kg/cm)		
Comparative Example 6	392	40	30	0.15
Comparative Example 7	588	60	20	0.15
Comparative Example 8	441	45	30	0.15
Comparative Example 9	-	-	-	-
Comparative Example 10	588	60	20	6×10^{-4}
Comparative Example 11	588	60	30	0.15
Comparative Example 12	441	45	30	0.15
Comparative Example 13	490	50	30	0.15
Comparative Example 14	-	-	-	-
Comparative Example 15	441	45	30	6×10^{-4}
Comparative Example 16	588	60	30	0.30

Table 10 (continued)

Comparative Examples	Production of composite particles	
	Adhering step with second colored adhesion layer	
	Organic pigment	
	Kind	Amount adhered (wt. part)
Comparative Example 6	Y-2	10.0
Comparative Example 7	Y-2	10.0
Comparative Example 8	Y-2	0.1
Comparative Example 9	B-2	10.0
Comparative Example 10	B-2	10.0
Comparative Example 11	B-2	10.0
Comparative Example 12	B-2	10.0
Comparative Example 13	B-2	0.1
Comparative Example 14	Y-2	10.0
Comparative Example 15	Y-2	10.0
Comparative Example 16	Y-2	600.0

Table 10 (continued)

Comparative Examples	Production of composite particles			
	Adhering step with second colored adhesion layer			
	Edge runner treatment			Amount adhered (calculated as C) (wt. %)
	Linear load		Time (min.)	
	(N/cm)	(Kg/cm)		
Comparative Example 6	588	60	60	4.71
Comparative Example 7	784	80	60	4.73
Comparative Example 8	588	60	20	0.05
Comparative Example 9	441	45	120	6.00
Comparative Example 10	588	60	60	5.98
Comparative Example 11	441	45	30	5.97
Comparative Example 12	588	60	20	5.97
Comparative Example 13	490	50	60	0.06
Comparative Example 14	588	60	60	4.75
Comparative Example 15	588	60	30	4.73
Comparative Example 16	588	60	300	48.60

Table 11

Examples	Properties of composite particles	
	Average particle size (μm)	BET specific surface area value (m^2/g)
Example 28	0.27	11.6
Example 29	0.012	48.6
Example 30	0.19	18.8
Example 31	0.027	183.2
Example 32	0.009	276.5
Example 33	0.068	19.1
Example 34	8.25	7.1
Example 35	0.27	12.3
Example 36	0.011	58.6
Example 37	0.20	18.8
Example 38	0.028	163.6
Example 39	0.012	178.8
Example 40	0.067	20.6
Example 41	8.26	5.9

Table 11 (continued)

Examples	Properties of composite particles		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 28	9.56	8.26	-20.08
Example 29	69.33	1.73	78.15
Example 30	30.19	49.62	21.58
Example 31	7.93	10.53	-21.76
Example 32	31.73	54.63	25.05
Example 33	67.84	0.76	79.37
Example 34	11.34	6.36	-19.26
Example 35	28.88	51.33	20.84
Example 36	12.13	-16.65	-1.36
Example 37	63.20	1.26	81.00
Example 38	6.47	10.63	-22.12
Example 39	66.82	0.63	79.71
Example 40	25.43	56.13	24.91
Example 41	71.34	0.91	82.87

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 11 (continued)

Examples	Properties of composite particles		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 28	19.86	8.26	-23.22
Example 29	69.59	1.73	70.16
Example 30	35.35	49.62	16.39
Example 31	18.69	10.53	-24.82
Example 32	36.56	54.63	19.68
Example 33	68.13	0.76	71.32
Example 34	21.14	6.36	-22.44
Example 35	34.32	51.33	15.68
Example 36	22.12	-16.65	-5.42
Example 37	63.67	1.26	72.87
Example 38	17.65	10.63	-25.16
Example 39	67.13	0.63	71.65
Example 40	31.65	56.13	19.55
Example 41	71.59	0.91	74.65

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 11 (continued)

Examples	Properties of composite particles	
	Tinting strength (%)	Hiding power (cm ² /g)
Example 28	240	1,610
Example 29	243	510
Example 30	223	780
Example 31	254	540
Example 32	252	520
Example 33	236	480
Example 34	254	410
Example 35	238	1,530
Example 36	238	470
Example 37	232	790
Example 38	256	540
Example 39	243	490
Example 40	222	530
Example 41	218	450

Table 11 (continued)

Examples	Properties of composite particles		
	Light resistance (ΔE^* value) (-)	Desorption percentage of organic pigment (%)	Degree of desorption of organic pigment (-)
Example 28	2.10	6.0	-
Example 29	2.11	6.8	-
Example 30	2.88	6.0	-
Example 31	1.04	-	5
Example 32	1.32	-	5
Example 33	2.06	6.9	-
Example 34	2.16	7.3	-
Example 35	1.66	4.0	-
Example 36	1.63	3.8	-
Example 37	1.68	4.6	-
Example 38	0.95	-	5
Example 39	1.59	-	5
Example 40	1.69	4.0	-
Example 41	1.14	4.1	-

Table 12

Examples	Properties of composite particles	
	Average particle size (μm)	BET specific surface area value (m^2/g)
Example 42	0.27	12.8
Example 43	0.018	47.8
Example 44	0.20	19.1
Example 45	0.030	179.6
Example 46	0.008	278.8
Example 47	0.068	24.6
Example 48	8.25	7.9
Example 49	0.27	13.3
Example 50	0.014	51.2
Example 51	0.20	18.9
Example 52	0.027	156.8
Example 53	0.010	171.9
Example 54	0.068	21.9
Example 55	8.26	6.1

Table 12 (continued)

Examples	Properties of composite particles		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 42	20.07	31.32	10.62
Example 43	14.78	-15.26	7.79
Example 44	42.65	21.32	51.17
Example 45	40.49	-14.11	1.69
Example 46	9.31	39.14	2.19
Example 47	12.01	-13.99	11.37
Example 48	30.77	3.24	24.57
Example 49	16.52	26.33	10.92
Example 50	12.03	-13.65	19.78
Example 51	21.49	31.53	46.50
Example 52	12.39	-12.59	3.12
Example 53	38.11	28.26	41.83
Example 54	9.27	30.16	0.13
Example 55	31.92	3.24	-16.78

(Note) 1): Measured by a portable spectrophotometer
 "COLOR- GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 12 (continued)

Examples	Properties of composite particles		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 42	27.58	31.32	5.97
Example 43	28.65	-15.26	3.28
Example 44	45.44	21.32	44.52
Example 45	43.64	-14.11	-2.52
Example 46	19.68	39.14	-2.05
Example 47	21.63	-13.99	6.68
Example 48	35.80	3.24	-19.23
Example 49	24.93	26.33	6.25
Example 50	21.64	-13.65	14.67
Example 51	28.65	31.53	40.08
Example 52	22.29	-12.59	-1.16
Example 53	41.69	28.26	35.64
Example 54	19.65	30.16	-4.01
Example 55	36.71	3.24	-20.08

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 12 (continued)

Examples	Properties of composite particles	
	Tinting strength (%)	Hiding power (cm ² /g)
Example 42	225	1,890
Example 43	251	530
Example 44	230	830
Example 45	226	530
Example 46	223	490
Example 47	241	510
Example 48	244	430
Example 49	255	2,130
Example 50	249	500
Example 51	231	990
Example 52	248	510
Example 53	249	480
Example 54	241	530
Example 55	217	560

Table 12 (continued)

Examples	Properties of composite particles		
	Light resistance (ΔE^* value) (-)	Desorption percentage of organic pigment (%)	Degree of desorption of organic pigment (-)
Example 42	2.32	6.9	-
Example 43	1.64	8.7	-
Example 44	2.16	8.6	-
Example 45	1.23	-	5
Example 46	1.41	-	5
Example 47	1.82	8.6	-
Example 48	2.32	8.9	-
Example 49	1.68	5.6	-
Example 50	1.72	4.1	-
Example 51	1.65	5.7	-
Example 52	1.18	-	5
Example 53	1.36	-	5
Example 54	1.72	4.9	-
Example 55	1.62	3.1	-

Table 13

Comparative Examples	Properties of composite particles	
	Average particle size (μm)	BET specific surface area value (m^2/g)
Comparative Example 6	0.26	11.3
Comparative Example 7	0.26	12.6
Comparative Example 8	0.25	13.2
Comparative Example 9	0.26	14.3
Comparative Example 10	0.26	10.6
Comparative Example 11	0.26	11.6
Comparative Example 12	0.26	17.3
Comparative Example 13	0.25	18.1
Comparative Example 14	0.26	12.6
Comparative Example 15	0.26	13.6
Comparative Example 16	0.28	12.1

Table 13 (continued)

Comparative Examples	Properties of composite particles		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Comparative Example 6	62.50	0.90	77.60
Comparative Example 7	65.30	0.69	78.61
Comparative Example 8	90.84	1.26	7.16
Comparative Example 9	66.29	5.26	-21.52
Comparative Example 10	64.25	3.10	-18.62
Comparative Example 11	63.00	1.32	-15.98
Comparative Example 12	58.10	0.18	-19.56
Comparative Example 13	61.19	1.96	-16.39
Comparative Example 14	30.84	15.14	-10.82
Comparative Example 15	28.22	20.12	-8.85
Comparative Example 16	68.04	-4.26	62.59

(Note) 1): Measured by a portable spectrophotometer
"COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
JAPAN CO., LTD.)

Table 13 (continued)

Comparative Examples	Properties of composite particles		
	Hue		
	L* value2) (-)	a* value2) (-)	b* value2) (-)
Comparative Example 6	63.01	0.90	69.64
Comparative Example 7	65.67	0.69	70.60
Comparative Example 8	92.85	1.26	2.68
Comparative Example 9	66.62	5.26	-24.59
Comparative Example 10	64.66	3.10	-21.83
Comparative Example 11	63.48	1.32	-19.32
Comparative Example 12	58.93	0.18	-22.72
Comparative Example 13	61.78	1.96	-19.71
Comparative Example 14	35.86	15.14	-14.42
Comparative Example 15	33.81	20.12	-12.54
Comparative Example 16	68.32	-4.26	55.37

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 13 (continued)

Comparative Examples	Properties of composite particles	
	Tinting strength (%)	Hiding power (cm ² /g)
Comparative Example 6	106	1,460
Comparative Example 7	103	1,400
Comparative Example 8	101	1,460
Comparative Example 9	131	1,510
Comparative Example 10	131	1,500
Comparative Example 11	121	1,420
Comparative Example 12	124	1,460
Comparative Example 13	101	1,480
Comparative Example 14	116	1,510
Comparative Example 15	116	1,460
Comparative Example 16	198	1,630

Table 13 (continued)

Examples	Properties of composite particles	
	Light resistance (ΔE^* value) (-)	Desorption percentage of organic pigment (%)
Comparative Example 6	6.56	64.3
Comparative Example 7	6.34	56.2
Comparative Example 8	7.13	-
Comparative Example 9	8.12	71.3
Comparative Example 10	6.15	73.8
Comparative Example 11	8.36	61.6
Comparative Example 12	7.36	73.2
Comparative Example 13	6.53	-
Comparative Example 14	7.01	68.6
Comparative Example 15	7.81	67.2
Comparative Example 16	6.17	56.3

Table 14

Examples	Production of paint	Properties of paint	
	Kind of composite particles	Viscosity (cP)	Storage stability (-)
Example 56	Example 12	1,024	0.90
Example 57	Example 13	922	0.76
Example 58	Example 14	1,152	0.83
Example 59	Example 15	870	0.78
Example 60	Example 16	845	0.64
Example 61	Example 17	1,100	0.95
Example 62	Example 18	1,050	0.84
Example 63	Example 19	998	0.54
Example 64	Example 20	1,075	0.43
Example 65	Example 21	1,062	0.21
Example 66	Example 22	1,050	0.36
Example 67	Example 23	1,024	0.21
Example 68	Example 24	998	0.55
Example 69	Example 25	1,203	0.38
Example 70	Example 26	973	0.91
Example 71	Example 27	947	0.88

Table 14 (continued)

Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 56	93	55.51	48.99	-1.03
Example 57	93	52.99	31.88	26.07
Example 58	96	63.32	-5.63	-27.32
Example 59	94	14.76	9.13	-17.38
Example 60	96	57.26	48.61	24.36
Example 61	93	82.35	2.65	77.47
Example 62	93	81.93	0.93	84.56
Example 63	97	46.52	53.16	5.63
Example 64	98	35.39	-18.11	-6.15
Example 65	86	31.83	-7.63	-28.39
Example 66	96	11.28	9.13	-17.37
Example 67	93	52.48	40.12	0.52
Example 68	97	17.13	-16.64	-9.77
Example 69	91	82.03	0.83	85.36
Example 70	92	12.49	2.48	-11.00
Example 71	94	15.16	-15.06	-8.96

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 14 (continued)

Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 56	56.33	48.99	-4.72
Example 57	54.33	31.88	20.65
Example 58	63.69	-5.63	-29.50
Example 59	23.64	9.13	-20.65
Example 60	58.16	48.61	19.03
Example 61	83.13	2.65	69.52
Example 62	82.70	0.93	75.93
Example 63	48.31	53.16	1.55
Example 64	39.64	-18.11	-9.98
Example 65	36.25	-7.63	-30.51
Example 66	21.10	9.13	-20.64
Example 67	53.88	40.12	-3.64
Example 68	25.49	-16.64	-13.42
Example 69	82.80	0.83	76.68
Example 70	21.98	2.48	-14.59
Example 71	24.14	-15.06	-12.20

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 14 (continued)

Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Example 56	2.77	-
Example 57	2.64	0.0813
Example 58	2.59	-
Example 59	1.46	0.0836
Example 60	1.68	0.0812
Example 61	2.31	0.0794
Example 62	3.14	0.0703
Example 63	1.93	-
Example 64	2.24	0.0821
Example 65	1.64	-
Example 66	1.23	0.0844
Example 67	1.46	0.0796
Example 68	2.23	0.0772
Example 69	2.03	0.0716
Example 70	2.70	-
Example 71	2.15	0.0837

Table 15

Examples	Production of paint	Properties of paint	
	Kind of composite particles	Viscosity (cP)	Storage stability (-)
Example 72	Example 28	973	0.86
Example 73	Example 29	1,256	0.78
Example 74	Example 30	1,050	0.83
Example 75	Example 31	984	0.64
Example 76	Example 32	1,019	0.68
Example 77	Example 33	983	0.89
Example 78	Example 34	1,024	0.78
Example 79	Example 35	998	0.43
Example 80	Example 36	1,256	0.35
Example 81	Example 37	1,024	0.42
Example 82	Example 38	972	0.33
Example 83	Example 39	1,031	0.26
Example 84	Example 40	1,152	0.44
Example 85	Example 41	896	0.36

Table 15 (continued)

Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value1) (-)	a* value1) (-)	b* value1) (-)
Example 72	94	10.17	7.21	-21.25
Example 73	91	71.07	1.13	81.81
Example 74	93	33.10	49.21	22.36
Example 75	93	9.27	10.69	-18.41
Example 76	92	32.45	53.26	26.55
Example 77	91	68.90	1.09	80.42
Example 78	94	12.29	7.34	-20.63
Example 79	98	31.13	49.63	15.89
Example 80	97	13.65	-16.84	-3.41
Example 81	96	66.34	1.26	83.47
Example 82	98	7.19	9.64	-21.62
Example 83	99	68.08	1.26	81.30
Example 84	95	26.09	58.32	27.12
Example 85	97	77.72	0.93	79.38

(Note) 1): Measured by a portable spectrophotometer
 "COLOR- GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN
 CO., LTD.)

Table 15 (continued)

Examples	Properties of coating film		
	Hue		
	L* value2) (-)	a* value2) (-)	b* value2) (-)
Example 72	20.30	7.21	-24.33
Example 73	71.32	1.13	73.64
Example 74	37.65	49.21	17.13
Example 75	19.65	10.69	-21.63
Example 76	37.13	53.26	21.11
Example 77	69.16	1.09	72.32
Example 78	21.83	7.34	-23.74
Example 79	36.09	49.63	10.98
Example 80	23.13	-16.84	-7.37
Example 81	66.67	1.26	75.22
Example 82	18.16	9.64	-24.68
Example 83	68.36	1.26	73.16
Example 84	32.16	58.32	21.65
Example 85	78.15	0.93	71.33

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 15 (continued)

Examples	Properties of coating film	
	Light resistance	Transparency
	(ΔE^* value) (-)	(linear absorption) (μm^{-1})
Example 72	2.68	-
Example 73	2.66	0.0824
Example 74	2.13	-
Example 75	1.48	0.0838
Example 76	1.76	0.0829
Example 77	2.34	0.0796
Example 78	2.13	0.0812
Example 79	1.68	-
Example 80	1.71	0.0758
Example 81	1.66	-
Example 82	1.26	0.0820
Example 83	1.61	0.0772
Example 84	1.68	0.0816
Example 85	1.69	0.0738

Table 16

Examples	Production of paint	Properties of paint	
	Kind of composite particles	Viscosity (cP)	Storage stability (-)
Example 86	Example 42	922	0.78
Example 87	Example 43	1,114	0.69
Example 88	Example 44	1,050	0.68
Example 89	Example 45	1,024	0.63
Example 90	Example 46	963	0.64
Example 91	Example 47	1,256	0.83
Example 92	Example 48	1,152	0.71
Example 93	Example 49	998	0.36
Example 94	Example 50	983	0.35
Example 95	Example 51	1,050	0.41
Example 96	Example 52	1,021	0.26
Example 97	Example 53	944	0.26
Example 98	Example 54	1,157	0.40
Example 99	Example 55	973	0.21

Table 16 (continued)

Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 86	90	24.86	34.62	11.92
Example 87	92	21.06	-14.11	7.53
Example 88	91	43.49	25.66	56.73
Example 89	92	39.84	-13.64	1.00
Example 90	93	12.01	37.84	2.49
Example 91	91	15.42	-12.95	12.21
Example 92	94	30.78	4.62	-18.06
Example 93	99	18.37	27.83	14.60
Example 94	103	16.11	-11.62	18.98
Example 95	101	24.37	29.65	43.66
Example 96	100	3.51	-13.16	1.67
Example 97	104	40.10	27.65	43.60
Example 98	98	11.58	29.66	-1.30
Example 99	99	34.79	5.62	-19.59

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 16 (continued)

Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 86	31.21	34.62	7.20
Example 87	28.32	-14.11	3.03
Example 88	46.14	25.66	49.80
Example 89	43.11	-13.64	-3.18
Example 90	21.63	37.84	-1.76
Example 91	24.12	-12.95	7.48
Example 92	35.81	4.62	-21.30
Example 93	26.31	27.83	9.75
Example 94	24.63	-11.62	13.91
Example 95	30.84	29.65	37.38
Example 96	15.56	-13.16	-2.54
Example 97	43.32	27.65	37.32
Example 98	21.32	29.66	-5.37
Example 99	39.00	5.62	-22.75

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 16 (continued)

Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Example 86	2.73	-
Example 87	1.98	0.0837
Example 88	2.16	-
Example 89	1.53	0.0830
Example 90	1.76	0.0791
Example 91	2.11	0.0807
Example 92	2.36	0.0812
Example 93	1.51	-
Example 94	1.84	0.0783
Example 95	1.53	-
Example 96	1.26	0.0786
Example 97	1.53	0.0768
Example 98	1.86	0.0799
Example 99	1.67	0.0791

Table 17

Comparative Examples	Production of paint	Properties of paint	
	Kind of organic pigments or composite particles	Viscosity (cP)	Storage stability (-)
Comparative Example 17	Organic pigment B-1	12,560	2.69
Comparative Example 18	Organic pigment B-2	13,814	3.13
Comparative Example 19	Organic pigment G-1	9,621	2.16
Comparative Example 20	Organic pigment R-1	11,211	2.11
Comparative Example 21	Organic pigment R-2	13,264	3.26
Comparative Example 22	Organic pigment R-3	9,863	2.43
Comparative Example 23	Organic pigment Y-1	7,652	3.16
Comparative Example 24	Organic pigment Y-2	6,835	2.93
Comparative Example 25	Comparative Example 1	12,186	2.13
Comparative Example 26	Comparative Example 2	1,050	1.69
Comparative Example 27	Comparative Example 3	10,240	2.11
Comparative Example 28	Comparative Example 4	1,664	1.83
Comparative Example 29	Comparative Example 5	2,650	2.16

Table 17 (continued)

Comparative Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Comparative Example 17	66	7.41	8.96	-19.51
Comparative Example 18	63	6.98	11.20	-26.01
Comparative Example 19	58	12.36	-18.48	-4.51
Comparative Example 20	63	32.83	52.16	26.81
Comparative Example 21	68	23.46	59.13	27.15
Comparative Example 22	71	37.66	48.65	25.50
Comparative Example 23	56	67.54	1.11	79.69
Comparative Example 24	53	69.10	1.63	81.30
Comparative Example 25	58	57.32	-2.64	-23.54
Comparative Example 26	71	90.66	0.60	2.38
Comparative Example 27	64	56.83	-2.13	-24.93
Comparative Example 28	73	74.63	-0.98	-3.66
Comparative Example 29	68	9.27	10.26	-18.43

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 17 (continued)

Comparative Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Comparative Example 17	18.32	8.96	-22.68
Comparative Example 18	18.01	11.20	-28.86
Comparative Example 19	22.27	-18.48	-8.42
Comparative Example 20	37.43	52.16	21.36
Comparative Example 21	30.14	59.13	21.68
Comparative Example 22	41.32	48.65	20.11
Comparative Example 23	67.83	1.11	71.63
Comparative Example 24	69.36	1.63	73.16
Comparative Example 25	58.00	-2.64	-25.94
Comparative Example 26	92.33	0.60	-1.51
Comparative Example 27	57.55	-2.13	-27.25
Comparative Example 28	74.99	-0.98	-7.20
Comparative Example 29	19.65	10.26	-21.65

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 17 (continued)

Comparative Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Comparative Example 17	10.23	0.1262
Comparative Example 18	10.24	0.1365
Comparative Example 19	9.93	0.1126
Comparative Example 20	13.84	0.1962
Comparative Example 21	17.16	0.1123
Comparative Example 22	18.32	0.1843
Comparative Example 23	17.56	0.1468
Comparative Example 24	19.32	0.1365
Comparative Example 25	7.68	-
Comparative Example 26	6.90	-
Comparative Example 27	6.96	-
Comparative Example 28	6.72	-
Comparative Example 29	10.26	-

Table 18

Comparative Examples	Production of paint	Properties of paint	
	Kind of composite particles	Viscosity (cP)	Storage stability (-)
Comparative Example 30	Comparative Example 6	4,832	2.31
Comparative Example 31	Comparative Example 7	16,212	2.31
Comparative Example 32	Comparative Example 8	2,164	2.16
Comparative Example 33	Comparative Example 9	13,212	2.46
Comparative Example 34	Comparative Example 10	4,321	2.13
Comparative Example 35	Comparative Example 11	5,662	2.13
Comparative Example 36	Comparative Example 12	8,962	2.46
Comparative Example 37	Comparative Example 13	2,011	2.52
Comparative Example 38	Comparative Example 14	9,099	2.18
Comparative Example 39	Comparative Example 15	10,113	2.29
Comparative Example 40	Comparative Example 16	18,432	2.11

Table 18 (continued)

Comparative Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Comparative Example 30	61	63.05	1.93	76.41
Comparative Example 31	65	66.06	2.62	72.96
Comparative Example 32	66	89.02	3.82	7.47
Comparative Example 33	68	61.49	5.21	-19.61
Comparative Example 34	71	66.07	2.92	-16.35
Comparative Example 35	66	61.50	2.16	-12.70
Comparative Example 36	63	64.01	1.68	-20.63
Comparative Example 37	66	65.04	2.34	-16.78
Comparative Example 38	62	32.16	16.12	-14.10
Comparative Example 39	65	30.69	21.11	-10.61
Comparative Example 40	70	65.26	1.04	58.26

(Note) 1): Measured by a portable spectrophotometer
"COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
JAPAN CO., LTD.)

Table 18 (continued)

Comparative Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Comparative Example 30	63.53	1.93	68.51
Comparative Example 31	66.40	2.62	65.23
Comparative Example 32	90.70	3.82	2.97
Comparative Example 33	62.06	5.21	-22.77
Comparative Example 34	66.41	2.92	-19.67
Comparative Example 35	62.07	2.16	-16.20
Comparative Example 36	64.44	1.68	-23.74
Comparative Example 37	65.42	2.34	-20.08
Comparative Example 38	36.90	16.12	-17.53
Comparative Example 39	35.74	21.11	-14.22
Comparative Example 40	65.63	1.04	51.26

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 18 (continued)

Comparative Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Comparative Example 30	6.82	-
Comparative Example 31	6.56	-
Comparative Example 32	6.25	-
Comparative Example 33	5.83	-
Comparative Example 34	6.58	-
Comparative Example 35	7.32	-
Comparative Example 36	8.16	-
Comparative Example 37	7.77	-
Comparative Example 38	6.21	-
Comparative Example 39	5.92	-
Comparative Example 40	6.68	-

Table 19

Examples	Production of solvent-based pigment dispersion (mill base)	
	Composite particles	
	Kind	Amount blended (wt. part)
Example 100	Example 12	40
Example 101	Example 15	40
Example 102	Example 16	40
Example 103	Example 17	40
Example 104	Example 18	40
Example 105	Example 20	40
Example 106	Example 21	40
Example 107	Example 22	40
Example 108	Example 12	45
Example 109	Example 15	45
Example 110	Example 12	90
Example 111	Example 15	90
Example 112	Example 12	20
Example 113	Example 12	10
Example 114	Example 12	20

Table 19 (continued)

Examples	Production of solvent-based pigment dispersion (mill base)			
	Resin		Solvent	
	Kind	Amount blended (wt. part)	Kind	Amount blended (wt. part)
Example 100	Amino alkyd resin	20	Thinner	40
Example 101	Amino alkyd resin	20	Thinner	40
Example 102	Amino alkyd resin	20	Thinner	40
Example 103	Amino alkyd resin	20	Thinner	40
Example 104	Amino alkyd resin	20	Thinner	40
Example 105	Amino alkyd resin	20	Thinner	40
Example 106	Amino alkyd resin	20	Thinner	40
Example 107	Amino alkyd resin	20	Thinner	40
Example 108	Nitrocellulose	50	Ethyl acetate	5
Example 109	Nitrocellulose	50	Ethyl acetate	5
Example 110	Rosin-modified phenol resin	10	-	-
Example 111	Rosin-modified phenol resin	10	-	-
Example 112	Alkyd resin Melamine resin	50 20	Xylene	10
Example 113	Nitrocellulose	90	-	-
Example 114	Urethane resin	80	-	-

Table 20

Examples	Production of pigment dispersion (mill base)	
	Composite particles	
	Kind	Amount blended (wt. part)
Example 115	Example 28	40
Example 116	Example 31	40
Example 117	Example 32	40
Example 118	Example 33	40
Example 119	Example 34	40
Example 120	Example 36	40
Example 121	Example 37	40
Example 122	Example 38	40
Example 123	Example 42	40
Example 124	Example 45	40
Example 125	Example 47	40
Example 126	Example 48	40
Example 127	Example 28	45
Example 128	Example 31	45
Example 129	Example 28	90
Example 130	Example 31	90
Example 131	Example 28	20
Example 132	Example 28	10
Example 133	Example 28	20

Table 20 (continued)

Examples	Production of pigment dispersion (mill base)			
	Resin		Solvent	
	Kind	Amount blended (wt. part)	Kind	Amount blended (wt. part)
Example 115	Amino alkyd resin	20	Thinner	40
Example 116	Amino alkyd resin	20	Thinner	40
Example 117	Amino alkyd resin	20	Thinner	40
Example 118	Amino alkyd resin	20	Thinner	40
Example 119	Amino alkyd resin	20	Thinner	40
Example 120	Amino alkyd resin	20	Thinner	40
Example 121	Amino alkyd resin	20	Thinner	40
Example 122	Amino alkyd resin	20	Thinner	40
Example 123	Amino alkyd resin	20	Thinner	40
Example 124	Amino alkyd resin	20	Thinner	40
Example 125	Amino alkyd resin	20	Thinner	40
Example 126	Amino alkyd resin	20	Thinner	40
Example 127	Nitrocellulose	50	Ethyl acetate	5
Example 128	Nitrocellulose	50	Ethyl acetate	5
Example 129	Rosin-modified phenol resin	10	-	-
Example 130	Rosin-modified phenol resin	10	-	-
Example 131	Alkyd resin	50	Xylene	10
	Melamine resin	20		
Example 132	Nitrocellulose	90	-	-
Example 133	Urethane resin	80	-	-

Table 21

Examples	Production of paint	
	Solvent-based pigment dispersion	
	Solvent-based pigment dispersion	Amount blended (wt. part)
Example 134	Example 100	39.0
Example 135	Example 101	39.0
Example 136	Example 102	39.0
Example 137	Example 103	39.0
Example 138	Example 104	39.0
Example 139	Example 105	39.0
Example 140	Example 106	39.0
Example 141	Example 107	39.0

Table 21 (continued)

Examples	Production of paint	
	Resin	
	Kind	Amount blended (wt. part)
Example 134	Amino alkyd resin	61.0
Example 135	Amino alkyd resin	61.0
Example 136	Amino alkyd resin	61.0
Example 137	Amino alkyd resin	61.0
Example 138	Amino alkyd resin	61.0
Example 139	Amino alkyd resin	61.0
Example 140	Amino alkyd resin	61.0
Example 141	Amino alkyd resin	61.0

Table 22

Examples	Production of paint	
	Solvent-based pigment dispersion	
	Kind	Amount blended (wt. part)
Example 142	Example 115	39.0
Example 143	Example 116	39.0
Example 144	Example 117	39.0
Example 145	Example 118	39.0
Example 146	Example 119	39.0
Example 147	Example 120	39.0
Example 148	Example 121	39.0
Example 149	Example 122	39.0
Example 150	Example 123	39.0
Example 151	Example 124	39.0
Example 152	Example 125	39.0
Example 153	Example 126	39.0

Table 22 (continued)

Examples	Production of paint	
	Resin	
	Kind	Amount blended (wt. part)
Example 142	Amino alkyd resin	61.0
Example 143	Amino alkyd resin	61.0
Example 144	Amino alkyd resin	61.0
Example 145	Amino alkyd resin	61.0
Example 146	Amino alkyd resin	61.0
Example 147	Amino alkyd resin	61.0
Example 148	Amino alkyd resin	61.0
Example 149	Amino alkyd resin	61.0
Example 150	Amino alkyd resin	61.0
Example 151	Amino alkyd resin	61.0
Example 152	Amino alkyd resin	61.0
Example 153	Amino alkyd resin	61.0

Table 23

Examples	Properties of paint	
	Viscosity (cP)	Storage stability (-)
Example 134	873	0.86
Example 135	724	0.71
Example 136	703	0.60
Example 137	914	0.90
Example 138	856	0.81
Example 139	870	0.41
Example 140	853	0.19
Example 141	847	0.33

Table 23 (continued)

Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 134	100	55.79	49.18	-0.03
Example 135	103	14.82	9.03	-17.59
Example 136	104	57.48	48.59	24.45
Example 137	101	79.59	2.64	77.06
Example 138	102	82.36	1.16	84.41
Example 139	107	35.57	-18.13	-6.22
Example 140	96	33.70	-7.36	-28.95
Example 141	109	15.04	9.12	-17.98

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 23 (continued)

Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 134	56.83	49.18	-4.16
Example 135	23.68	9.03	-20.85
Example 136	58.36	48.59	19.11
Example 137	80.13	2.64	69.13
Example 138	83.14	1.16	76.12
Example 139	39.63	-18.13	-10.04
Example 140	38.13	-7.36	-31.65
Example 141	23.84	9.12	-21.22

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 23 (continued)

Examples	Properties of coating film	
	Light resistance	Transparency
	(ΔE^* value) (-)	(linear absorption) (μm^{-1})
Example 134	2.56	-
Example 135	1.41	0.0683
Example 136	1.65	0.0644
Example 137	2.24	0.0598
Example 138	2.84	0.0546
Example 139	2.07	0.0695
Example 140	1.54	-
Example 141	1.16	0.0702

Table 24

Examples	Properties of paint	
	Viscosity (cP)	Storage stability (-)
Example 142	823	0.83
Example 143	842	0.61
Example 144	897	0.65
Example 145	830	0.85
Example 146	872	0.76
Example 147	1,111	0.34
Example 148	894	0.38
Example 149	826	0.31
Example 150	778	0.75
Example 151	901	0.60
Example 152	1,094	0.80
Example 153	1,003	0.69

Table 24 (continued)

Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 142	102	9.66	7.74	-20.67
Example 143	104	71.13	10.32	-20.02
Example 144	102	32.49	53.32	25.84
Example 145	99	8.59	1.01	80.26
Example 146	104	34.02	7.14	-20.39
Example 147	106	69.27	-16.38	-2.63
Example 148	105	14.41	1.51	81.86
Example 149	110	28.93	10.12	-21.75
Example 150	98	13.16	32.50	11.41
Example 151	100	64.93	-13.76	1.08
Example 152	100	8.81	-13.18	12.03
Example 153	104	68.90	4.03	-17.29

(Note) 1): Measured by a portable spectrophotometer
 "COLOR- GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 24 (continued)

Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 142	19.93	7.74	-23.78
Example 143	71.38	10.32	-23.16
Example 144	37.16	53.32	20.44
Example 145	19.16	1.01	72.17
Example 146	38.38	7.14	-23.51
Example 147	69.53	-16.38	-6.63
Example 148	23.38	1.51	73.69
Example 149	34.36	10.12	-24.81
Example 150	22.80	32.50	6.72
Example 151	65.31	-13.76	-3.10
Example 152	19.32	-13.18	7.31
Example 153	69.16	4.03	-20.57

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 24 (continued)

Examples	Properties of coating film	
	Light resistance	Transparency
	(ΔE^* value) (-)	(linear absorption) (μm^{-1})
Example 142	2.53	-
Example 143	1.33	0.0698
Example 144	1.67	0.0681
Example 145	2.23	0.0612
Example 146	2.04	0.0643
Example 147	1.68	0.0588
Example 148	1.63	-
Example 149	1.22	0.0687
Example 150	2.61	-
Example 151	1.46	0.0701
Example 152	2.06	0.0674
Example 153	2.27	0.0672

Table 25

Examples	Production of water-based paint	Properties of paint	
	Kind of composite particles	Viscosity (cP)	Storage stability (-)
Example 154	Example 12	2,073	0.88
Example 155	Example 13	2,560	0.57
Example 156	Example 14	2,150	0.64
Example 157	Example 15	1,883	0.59
Example 158	Example 16	1,964	0.58
Example 159	Example 17	2,123	0.91
Example 160	Example 18	2,380	0.90
Example 161	Example 19	2,150	0.41
Example 162	Example 20	2,262	0.40
Example 163	Example 21	2,022	0.31
Example 164	Example 22	2,586	0.28
Example 165	Example 23	2,301	0.29
Example 166	Example 24	2,284	0.42
Example 167	Example 25	2,176	0.41
Example 168	Example 26	2,169	0.90
Example 169	Example 27	2,048	0.92

Table 25 (continued)

Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 154	91	54.32	47.13	-0.96
Example 155	92	53.38	29.66	24.46
Example 156	93	62.16	-5.32	-25.32
Example 157	94	14.33	9.86	-17.37
Example 158	92	57.99	46.36	22.24
Example 159	86	80.69	1.14	73.75
Example 160	86	80.16	0.90	79.63
Example 161	93	45.36	52.26	4.92
Example 162	96	35.60	-16.37	-8.45
Example 163	96	30.36	-6.98	-27.32
Example 164	98	13.45	6.81	-21.28
Example 165	95	55.01	41.38	1.57
Example 166	92	17.34	-13.65	-9.95
Example 167	90	81.63	0.64	84.31
Example 168	92	14.76	1.41	-9.41
Example 169	94	15.69	-13.12	-9.19

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 25 (continued)

Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 154	55.24	47.13	-4.66
Example 155	54.68	29.66	19.12
Example 156	62.57	-5.32	-27.61
Example 157	23.32	9.86	-20.64
Example 158	58.83	46.36	17.01
Example 159	81.32	1.14	65.98
Example 160	80.80	0.90	71.28
Example 161	47.31	52.26	0.88
Example 162	39.65	-16.37	-12.16
Example 163	35.12	-6.98	-29.50
Example 164	22.68	6.81	-24.36
Example 165	56.13	41.38	-2.64
Example 166	25.63	-13.65	-13.59
Example 167	82.37	0.64	75.69
Example 168	23.64	1.41	-13.08
Example 169	24.50	-13.12	-12.87

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 25 (continued)

Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Example 154	2.68	-
Example 155	2.59	0.0863
Example 156	2.43	-
Example 157	1.48	0.0872
Example 158	1.63	0.0844
Example 159	2.36	0.0818
Example 160	3.51	0.0763
Example 161	1.99	-
Example 162	2.16	0.0810
Example 163	1.78	-
Example 164	1.33	0.0879
Example 165	1.56	0.0798
Example 166	2.49	0.0773
Example 167	2.44	0.0818
Example 168	2.74	-
Example 169	2.39	0.0899

Table 26

Examples	Production of water-based paint	Properties of paint	
	Kind of composite particles	Viscosity (cP)	Storage stability (-)
Example 170	Example 28	2,048	0.76
Example 171	Example 29	2,162	0.93
Example 172	Example 30	1,920	0.56
Example 173	Example 31	1,983	0.54
Example 174	Example 32	1,862	0.53
Example 175	Example 33	2,014	0.90
Example 176	Example 34	1,818	0.75
Example 177	Example 35	1,997	0.44
Example 178	Example 36	2,026	0.36
Example 179	Example 37	1,971	0.42
Example 180	Example 38	1,969	0.36
Example 181	Example 39	2,156	0.35
Example 182	Example 40	2,048	0.45
Example 183	Example 41	1,741	0.22

Table 26 (continued)

Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 170	93	10.20	9.21	-19.25
Example 171	95	71.07	1.68	82.35
Example 172	91	30.64	49.63	22.42
Example 173	94	11.46	13.62	-18.41
Example 174	96	34.40	51.24	26.81
Example 175	94	64.94	0.32	80.25
Example 176	90	14.96	8.26	-20.54
Example 177	103	26.47	52.62	20.31
Example 178	98	2.21	-19.63	-4.74
Example 179	100	62.03	3.26	80.64
Example 180	103	8.31	13.62	-20.00
Example 181	100	68.08	2.61	81.85
Example 182	98	28.12	58.65	26.60
Example 183	98	72.37	0.03	81.83

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 26 (continued)

Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 170	20.32	9.21	-22.43
Example 171	71.32	1.68	74.16
Example 172	35.70	49.63	17.18
Example 173	21.23	13.62	-21.63
Example 174	38.69	51.24	21.36
Example 175	65.32	0.32	72.16
Example 176	23.78	8.26	-23.66
Example 177	32.45	52.62	15.18
Example 178	14.65	-19.63	-8.64
Example 179	62.57	3.26	72.53
Example 180	18.96	13.62	-23.14
Example 181	68.36	2.61	73.68
Example 182	33.73	58.65	21.61
Example 183	72.62	0.03	73.66

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 26 (continued)

Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Example 170	2.56	-
Example 171	2.56	0.0862
Example 172	2.63	-
Example 173	1.49	0.0872
Example 174	1.63	0.0855
Example 175	2.48	0.0838
Example 176	2.65	0.0832
Example 177	1.86	-
Example 178	1.80	0.0786
Example 179	1.77	-
Example 180	1.32	0.0851
Example 181	1.82	0.0797
Example 182	1.99	0.0834
Example 183	1.72	0.0893

Table 27

Examples	Production of water-based paint	Properties of paint	
	Kind of composite particles	Viscosity (cP)	Storage stability (-)
Example 184	Example 42	1,946	0.65
Example 185	Example 43	2,048	0.63
Example 186	Example 44	1,997	0.68
Example 187	Example 45	2,560	0.65
Example 188	Example 46	2,078	0.64
Example 189	Example 47	1,997	0.71
Example 190	Example 48	2,074	0.53
Example 191	Example 49	1,971	0.21
Example 192	Example 50	1,870	0.17
Example 193	Example 51	1,920	0.16
Example 194	Example 52	1,946	0.14
Example 195	Example 53	2,048	0.15
Example 196	Example 54	2,160	0.34
Example 197	Example 55	2,074	0.33

Table 27 (continued)

Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Example 184	96	20.41	28.65	14.59
Example 185	95	16.11	-13.18	9.22
Example 186	87	44.68	22.11	53.57
Example 187	94	41.31	-12.87	3.28
Example 188	96	12.00	37.68	3.16
Example 189	92	10.60	-11.76	9.86
Example 190	95	28.28	1.68	-17.77
Example 191	98	18.32	21.68	11.98
Example 192	101	15.24	-16.32	-8.43
Example 193	99	22.96	32.65	44.62
Example 194	104	0.26	-14.54	1.83
Example 195	102	40.09	29.63	44.97
Example 196	99	12.03	32.48	-2.11
Example 197	99	32.70	4.69	-19.54

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 27 (continued)

Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Example 184	27.83	28.65	9.74
Example 185	24.63	-13.18	4.64
Example 186	47.14	22.11	46.80
Example 187	44.32	-12.87	-1.01
Example 188	21.62	37.68	-1.13
Example 189	20.61	-11.76	5.24
Example 190	33.85	1.68	-21.02
Example 191	26.27	21.68	7.26
Example 192	23.99	-16.32	-12.14
Example 193	29.76	32.65	38.29
Example 194	13.29	-14.54	-2.39
Example 195	43.31	29.63	38.62
Example 196	21.64	32.48	-6.14
Example 197	37.33	4.69	-22.71

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 27 (continued)

Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Example 184	2.32	-
Example 185	1.71	0.0871
Example 186	2.16	-
Example 187	1.44	0.0866
Example 188	1.56	0.840
Example 189	1.94	0.0851
Example 190	2.09	0.0892
Example 191	1.78	-
Example 192	1.74	0.0801
Example 193	1.68	-
Example 194	1.25	0.0808
Example 195	1.48	0.0792
Example 196	1.76	0.0826
Example 197	1.86	0.0864

Table 28

Comparative Examples	Production of water-based paint	Properties of paint	
	Kind of organic pigments or composite particles	Viscosity (cP)	Storage stability (-)
Comparative Example 41	Organic pigment B-1	18,623	3.13
Comparative Example 42	Organic pigment B-2	19,632	4.12
Comparative Example 43	Organic pigment G-1	21,560	3.14
Comparative Example 44	Organic pigment R-1	23,121	2.86
Comparative Example 45	Organic pigment R-2	18,621	3.16
Comparative Example 46	Organic pigment R-3	14,683	2.98
Comparative Example 47	Organic pigment Y-1	15,612	3.14
Comparative Example 48	Organic pigment Y-2	19,123	3.16
Comparative Example 49	Comparative Example 1	21,914	1.59
Comparative Example 50	Comparative Example 2	2,202	2.56
Comparative Example 51	Comparative Example 3	20,198	1.71
Comparative Example 52	Comparative Example 4	2,432	2.31
Comparative Example 53	Comparative Example 5	5,680	2.18

Table 28 (continued)

Comparative Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Comparative Example 41	56	6.45	7.14	-17.86
Comparative Example 42	51	6.53	10.91	-23.15
Comparative Example 43	46	12.10	-16.21	-7.26
Comparative Example 44	56	29.95	50.16	23.61
Comparative Example 45	61	20.84	57.61	25.01
Comparative Example 46	63	33.74	44.16	22.35
Comparative Example 47	28	62.68	0.08	74.36
Comparative Example 48	65	67.01	1.10	77.06
Comparative Example 49	46	56.66	-2.16	-23.60
Comparative Example 50	59	89.03	0.32	2.26
Comparative Example 51	50	56.32	-1.83	-24.62
Comparative Example 52	66	73.16	-0.82	-3.22
Comparative Example 53	48	7.84	11.62	-16.70

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 28 (continued)

Comparative Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Comparative Example 41	17.64	7.14	-21.11
Comparative Example 42	17.69	10.91	-26.14
Comparative Example 43	22.10	-16.21	-10.60
Comparative Example 44	35.16	50.16	-18.32
Comparative Example 45	28.16	57.61	19.65
Comparative Example 46	38.16	44.16	17.12
Comparative Example 47	63.18	0.08	66.56
Comparative Example 48	67.32	1.10	69.13
Comparative Example 49	57.39	-2.16	-25.99
Comparative Example 50	90.50	0.32	-1.62
Comparative Example 51	57.07	-1.83	-26.95
Comparative Example 52	73.48	-0.82	-6.79
Comparative Example 53	18.63	11.62	-20.01

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 28 (continued)

Comparative Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Comparative Example 41	12.16	0.1962
Comparative Example 42	11.32	0.2036
Comparative Example 43	10.91	0.1863
Comparative Example 44	15.62	0.2562
Comparative Example 45	19.32	0.1723
Comparative Example 46	19.69	0.2364
Comparative Example 47	19.23	0.2264
Comparative Example 48	21.62	0.2446
Comparative Example 49	7.01	-
Comparative Example 50	8.12	-
Comparative Example 51	7.63	-
Comparative Example 52	7.31	-
Comparative Example 53	11.16	-

Table 29

Comparative Examples	Production of water-based paint	Properties of paint	
	Kind of composite particles	Viscosity (cP)	Storage stability (-)
Comparative Example 54	Comparative Example 6	5,652	1.68
Comparative Example 55	Comparative Example 7	18,683	2.32
Comparative Example 56	Comparative Example 8	3,162	2.15
Comparative Example 57	Comparative Example 9	19,683	2.56
Comparative Example 58	Comparative Example 10	4,683	1.63
Comparative Example 59	Comparative Example 11	5,862	1.86
Comparative Example 60	Comparative Example 12	15,623	2.92
Comparative Example 61	Comparative Example 13	2,836	2.33
Comparative Example 62	Comparative Example 14	18,632	2.14
Comparative Example 63	Comparative Example 15	21,621	2.56
Comparative Example 64	Comparative Example 16	25,600	2.84

Table 29 (continued)

Comparative Examples	Properties of coating film			
	60° gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Comparative Example 54	56	63.05	1.86	76.24
Comparative Example 55	58	68.11	1.21	74.96
Comparative Example 56	63	81.66	1.58	10.41
Comparative Example 57	54	68.83	6.68	-19.56
Comparative Example 58	63	66.65	2.19	-20.65
Comparative Example 59	61	65.78	2.22	-17.28
Comparative Example 60	56	59.81	1.01	-18.76
Comparative Example 61	61	58.92	2.38	-17.07
Comparative Example 62	53	34.09	15.24	-10.98
Comparative Example 63	48	30.64	22.68	-7.74
Comparative Example 64	42	65.81	-2.82	59.72

(Note) 1): Measured by a portable spectrophotometer
 "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE
 JAPAN CO., LTD.)

Table 29 (continued)

Comparative Examples	Properties of coating film		
	Hue		
	L* value2) (-)	a* value2) (-)	b* value2) (-)
Comparative Example 54	63.53	1.86	68.35
Comparative Example 55	68.39	1.21	67.13
Comparative Example 56	82.37	1.58	5.77
Comparative Example 57	69.10	6.68	-22.72
Comparative Example 58	66.97	2.19	-23.76
Comparative Example 59	66.13	2.22	-20.56
Comparative Example 60	60.50	1.01	-21.96
Comparative Example 61	59.68	2.38	-20.36
Comparative Example 62	38.44	15.24	-14.57
Comparative Example 63	35.70	22.68	-11.49
Comparative Example 64	66.16	-2.82	52.64

(Note) 2): Measured by a multi-spectro-colour-meter
 "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES
 MANUFACTURING CO., LTD.)

Table 29 (continued)

Comparative Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Comparative Example 54	7.32	-
Comparative Example 55	6.83	-
Comparative Example 56	5.21	-
Comparative Example 57	6.38	-
Comparative Example 58	7.62	-
Comparative Example 59	6.66	-
Comparative Example 60	5.92	-
Comparative Example 61	6.31	-
Comparative Example 62	5.73	-
Comparative Example 63	7.83	-
Comparative Example 64	8.93	-

Table 30

Examples	Production of water-based pigment dispersion (mill base)	
	Composite particles	
	Kind	Amount blended (wt. part)
Example 198	Example 12	40.8
Example 199	Example 15	40.8
Example 200	Example 16	40.8
Example 201	Example 17	40.8
Example 202	Example 18	40.8
Example 203	Example 20	40.8
Example 204	Example 21	40.8
Example 205	Example 22	40.8
Example 206	Example 12	30.0
Example 207	Example 15	30.0
Example 208	Example 15	10.8
Example 209	Example 16	10.8
Example 210	Example 12	40.6
Example 211	Example 12	23.0
Example 212	Example 12	10.0
Example 213	Example 12	10.0
Example 214	Example 12	40.0

Table 30 (continued)

Examples	Production of water-based pigment dispersion (mill base)	
	Resin	
	Kind	Amount blended (wt. part)
Example 198	Water-soluble alkyd resin	29.6
Example 199	Water-soluble alkyd resin	29.6
Example 200	Water-soluble alkyd resin	29.6
Example 201	Water-soluble alkyd resin	29.6
Example 202	Water-soluble alkyd resin	29.6
Example 203	Water-soluble alkyd resin	29.6
Example 204	Water-soluble alkyd resin	29.6
Example 205	Water-soluble alkyd resin	29.6
Example 206	Water-soluble acrylic resin	56.0
Example 207	Water-soluble acrylic resin	56.0
Example 208	Styrene-acrylic acid- methacrylate resin	10.8
Example 209	Styrene-acrylic acid- methacrylate resin	10.8
Example 210	Polyoxyethylene-alkylamine	10.2
Example 211	Styrene-acrylic resin	5.0
	Styrene-acrylic emulsion	30.0
Example 212	Water-soluble acrylic resin	15.0
	Melamine resin	5.0
Example 213	Water-soluble polyester resin	15.0
	Melamine resin	5.0
Example 214	Water-soluble urethane resin	40.0

Table 30 (continued)

Examples	Production of water-based pigment dispersion (mill base)	
	Additives	
	Kind	Amount blended (wt. part)
Example 198	Anti-foaming agent	0.3
Example 199	Anti-foaming agent	0.3
Example 200	Anti-foaming agent	0.3
Example 201	Anti-foaming agent	0.3
Example 202	Anti-foaming agent	0.3
Example 203	Anti-foaming agent	0.3
Example 204	Anti-foaming agent	0.3
Example 205	Anti-foaming agent	0.3
Example 206	-	-
Example 207	-	-
Example 208	Glycerine	5.4
Example 209	Glycerine	5.4
Example 210	Ethylene glycol	10.2
Example 211	polyethylene wax	2.0
Example 212	-	-
Example 213	-	-
Example 214	-	-

Table 30 (continued)

Examples	Production of water-based pigment dispersion (mill base)	
	Solvent	
	Kind	Amount blended (wt. part)
Example 198	Water	15.8
	Butylcellosolve	13.5
Example 199	Water	15.8
	Butylcellosolve	13.5
Example 200	Water	15.8
	Butylcellosolve	13.5
Example 201	Water	15.8
	Butylcellosolve	13.5
Example 202	Water	15.8
	Butylcellosolve	13.5
Example 203	Water	15.8
	Butylcellosolve	13.5
Example 204	Water	15.8
	Butylcellosolve	13.5
Example 205	Water	15.8
	Butylcellosolve	13.5
Example 206	Water	14.0
Example 207	Water	14.0
Example 208	Water	62.2
	Isopropyl alcohol	10.8
Example 209	Water	62.2
	Isopropyl alcohol	10.8
Example 210	Water	39.1
Example 211	Water	30.0
	Isopropyl alcohol	10.0
Example 212	Water	70.0
Example 213	Water	70.0
Example 214	Ethanol	20.0

Table 31

Examples	Production of water-based pigment dispersion (mill base)	
	Composite particles	
	Kind	Amount blended (wt. part)
Examples 215	Examples 28	40.8
Examples 216	Examples 31	40.8
Examples 217	Examples 32	40.8
Examples 218	Examples 33	40.8
Examples 219	Examples 34	40.8
Examples 220	Examples 36	40.8
Examples 221	Examples 37	40.8
Examples 222	Examples 38	40.8
Examples 223	Examples 42	40.8
Examples 224	Examples 45	40.8
Examples 225	Examples 47	40.8
Examples 226	Examples 48	40.8
Examples 227	Examples 28	30.0
Examples 228	Examples 31	30.0
Examples 229	Examples 31	10.8
Examples 230	Examples 32	10.8
Examples 231	Examples 28	40.6
Examples 232	Examples 28	23.0
Examples 233	Examples 28	10.0
Examples 234	Examples 28	10.0
Examples 235	Examples 28	40.0

Table 31 (continued)

Examples	Production of water-based pigment dispersion (mill base)	
	Resin	
	Kind	Amount blended (wt. part)
Examples 215	Water-soluble alkyd resin	29.6
Examples 216	Water-soluble alkyd resin	29.6
Examples 217	Water-soluble alkyd resin	29.6
Examples 218	Water-soluble alkyd resin	29.6
Examples 219	Water-soluble alkyd resin	29.6
Examples 220	Water-soluble alkyd resin	29.6
Examples 221	Water-soluble alkyd resin	29.6
Examples 222	Water-soluble alkyd resin	29.6
Examples 223	Water-soluble alkyd resin	29.6
Examples 224	Water-soluble alkyd resin	29.6
Examples 225	Water-soluble alkyd resin	29.6
Examples 226	Water-soluble alkyd resin	29.6
Examples 227	Water-soluble acrylic resin	56.0
Examples 228	Water-soluble acrylic resin	56.0
Examples 229	Styrene-acrylic acid-methacrylate resin	10.8
Examples 230	Styrene-acrylic acid-methacrylate resin	10.8
Examples 231	Polyoxyethylene-alkylamine	10.2
Examples 232	Styrene-acrylic resin Styrene-acrylic emulsion	5.0 30.0
Examples 233	Water-soluble acrylic resin Melamine resin	15.0 5.0
Examples 234	Water-soluble polyester resin Melamine resin	15.0 5.0
Examples 235	Water-soluble urethane resin	40.0

Table 31 (continued)

Examples	Production of water-based pigment dispersion (mill base)	
	Additives	
	Kind	Amount blended (wt. part)
Examples 215	Anti-foaming agent	0.3
Examples 216	Anti-foaming agent	0.3
Examples 217	Anti-foaming agent	0.3
Examples 218	Anti-foaming agent	0.3
Examples 219	Anti-foaming agent	0.3
Examples 220	Anti-foaming agent	0.3
Examples 221	Anti-foaming agent	0.3
Examples 222	Anti-foaming agent	0.3
Examples 223	Anti-foaming agent	0.3
Examples 224	Anti-foaming agent	0.3
Examples 225	Anti-foaming agent	0.3
Examples 226	Anti-foaming agent	0.3
Examples 227	-	-
Examples 228	-	-
Examples 229	Glycerine	5.4
Examples 230	Glycerine	5.4
Examples 231	Ethylene glycol	10.2
Examples 232	polyethylene wax	2.0
Examples 233	-	-
Examples 234	-	-
Examples 235	-	-

Table 31 (continued)

Examples	Production of water-based pigment dispersion (mill base)	
	Solvent	
	Kind	Amount blended (wt. part)
Examples 215	Water	15.8
	Butylcellosolve	13.5
Examples 216	Water	15.8
	Butylcellosolve	13.5
Examples 217	Water	15.8
	Butylcellosolve	13.5
Examples 218	Water	15.8
	Butylcellosolve	13.5
Examples 219	Water	15.8
	Butylcellosolve	13.5
Examples 220	Water	15.8
	Butylcellosolve	13.5
Examples 221	Water	15.8
	Butylcellosolve	13.5
Examples 222	Water	15.8
	Butylcellosolve	13.5
Examples 223	Water	15.8
	Butylcellosolve	13.5
Examples 224	Water	15.8
	Butylcellosolve	13.5
Examples 225	Water	15.8
	Butylcellosolve	13.5
Examples 226	Water	15.8
	Butylcellosolve	13.5
Examples 227	Water	14.0
Examples 228	Water	14.0
Examples 229	Water	62.2
	Isopropyl alcohol	10.8
Examples 230	Water	62.2
	Isopropyl alcohol	10.8
Examples 231	Water	39.1
Examples 232	Water	30.0
	Isopropyl alcohol	10.0
Examples 233	Water	70.0
Examples 234	Water	70.0
Examples 235	Ethanol	20.0

Table 32

Examples	Production of paint	
	Water-based pigment dispersion	
	Kind	Amount blended (wt. part)
Examples 236	Example 198	30.4
Examples 237	Example 199	30.4
Examples 238	Example 200	30.4
Examples 239	Example 201	30.4
Examples 240	Example 202	30.4
Examples 241	Example 203	30.4
Examples 242	Example 204	30.4
Examples 243	Example 205	30.4

Table 32 (continued)

Examples	Production of paint	
	Resin	
	Kind	Amount blended (wt. part)
Examples 236	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 237	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 238	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 239	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 240	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 241	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 242	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 243	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6

Table 32 (continued)

Examples	Production of paint	
	Additives	
	Kind	Amount blended (wt. part)
Examples 236	Anti-foaming agent	0.1
Examples 237	Anti-foaming agent	0.1
Examples 238	Anti-foaming agent	0.1
Examples 239	Anti-foaming agent	0.1
Examples 240	Anti-foaming agent	0.1
Examples 241	Anti-foaming agent	0.1
Examples 242	Anti-foaming agent	0.1
Examples 243	Anti-foaming agent	0.1

Table 32 (continued)

Examples	Production of paint	
	Solvent	
	Kind	Amount blended (wt. part)
Examples 236	Water	9.1
Examples 237	Water	9.1
Examples 238	Water	9.1
Examples 239	Water	9.1
Examples 240	Water	9.1
Examples 241	Water	9.1
Examples 242	Water	9.1
Examples 243	Water	9.1

Table 33

Examples	Production of paint	
	Water-based pigment dispersion	
	Kind	Amount blended (wt. part)
Examples 244	Examples 215	30.4
Examples 245	Examples 216	30.4
Examples 246	Examples 217	30.4
Examples 247	Examples 218	30.4
Examples 248	Examples 219	30.4
Examples 249	Examples 220	30.4
Examples 250	Examples 221	30.4
Examples 251	Examples 222	30.4
Examples 252	Examples 223	30.4
Examples 253	Examples 224	30.4
Examples 254	Examples 225	30.4
Examples 255	Examples 226	30.4

Table 33 (continued)

Examples	Production of paint	
	Resin	
	Kind	Amount blended (wt. part)
Examples 244	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 245	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 246	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 247	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 248	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 249	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 250	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 251	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 252	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 253	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 254	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6
Examples 255	Water-soluble alkyd resin	46.2
	Water-soluble melamine resin	12.6

Table 33 (continued)

Examples	Production of paint	
	Additives	
	Kind	Amount blended (wt. part)
Examples 244	Anti-foaming agent	0.1
Examples 245	Anti-foaming agent	0.1
Examples 246	Anti-foaming agent	0.1
Examples 247	Anti-foaming agent	0.1
Examples 248	Anti-foaming agent	0.1
Examples 249	Anti-foaming agent	0.1
Examples 250	Anti-foaming agent	0.1
Examples 251	Anti-foaming agent	0.1
Examples 252	Anti-foaming agent	0.1
Examples 253	Anti-foaming agent	0.1
Examples 254	Anti-foaming agent	0.1
Examples 255	Anti-foaming agent	0.1

Table 33 (continued)

Examples	Production of paint	
	Solvent	
	Kind	Amount blended (wt. part)
Examples 244	Water	9.1
Examples 245	Water	9.1
Examples 246	Water	9.1
Examples 247	Water	9.1
Examples 248	Water	9.1
Examples 249	Water	9.1
Examples 250	Water	9.1
Examples 251	Water	9.1
Examples 252	Water	9.1
Examples 253	Water	9.1
Examples 254	Water	9.1
Examples 255	Water	9.1

Table 34

Examples	Properties of paint	
	Viscosity (cP)	Storage stability (-)
Examples 236	1,563	0.84
Examples 237	1,462	0.55
Examples 238	1,382	0.55
Examples 239	1,563	0.86
Examples 240	1,481	0.84
Examples 241	1,586	0.36
Examples 242	1,396	0.27
Examples 243	1,280	0.19

Table 34 (continued)

Examples	Properties of coating film			
	60° Gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Examples 236	96	57.43	47.32	0.53
Examples 237	98	14.82	8.16	-18.42
Examples 238	96	58.05	47.32	23.28
Examples 239	92	77.88	1.57	74.73
Examples 240	93	80.06	1.01	83.58
Examples 241	101	34.99	-17.63	-7.82
Examples 242	103	29.91	-7.32	-28.92
Examples 243	105	8.81	7.68	-19.46

(Note) 1): Measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.)

Table 34 (continued)

Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Examples 236	58.32	47.32	-3.63
Examples 237	23.68	8.16	-21.64
Examples 238	58.88	47.32	18.00
Examples 239	78.32	1.57	66.91
Examples 240	80.64	1.01	75.33
Examples 241	39.16	-17.63	-11.56
Examples 242	35.13	-7.32	-31.62
Examples 243	19.32	7.68	-22.63

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 34 (continued)

Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Examples 236	2.53	-
Examples 237	1.38	0.0722
Examples 238	1.60	0.0695
Examples 239	2.15	0.0678
Examples 240	3.36	0.0626
Examples 241	2.06	0.0663
Examples 242	1.67	-
Examples 243	1.29	0.0715

Table 35

Examples	Properties of water-based paint	
	Viscosity (cP)	Storage stability (-)
Examples 244	1,463	0.70
Examples 245	1,563	0.49
Examples 246	1,496	0.48
Examples 247	1,583	0.85
Examples 248	1,462	0.62
Examples 249	1,386	0.31
Examples 250	1,260	0.36
Examples 251	1,496	0.32
Examples 252	1,515	0.60
Examples 253	1,516	0.61
Examples 254	1,493	0.66
Examples 255	1,486	0.47

Table 35 (continued)

Examples	Properties of coating film			
	60° Gloss (%)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Examples 244	97	11.58	9.11	-19.39
Examples 245	98	9.31	11.99	-20.02
Examples 246	100	33.08	53.16	25.83
Examples 247	99	71.07	1.02	80.25
Examples 248	97	11.40	7.63	-18.75
Examples 249	103	13.16	-17.12	-7.16
Examples 250	105	67.83	1.66	80.22
Examples 251	108	7.19	11.16	-21.07
Examples 252	101	20.84	29.16	12.37
Examples 253	98	41.45	-13.64	3.00
Examples 254	97	14.76	-12.03	10.41
Examples 255	101	32.07	2.16	-17.72

(Note) 1): Measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.)

Table 35 (continued)

Examples	Properties of coating film		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Examples 244	21.32	9.11	-22.56
Examples 245	19.68	11.99	-23.16
Examples 246	37.63	53.16	20.43
Examples 247	71.32	1.02	72.16
Examples 248	21.19	7.63	-21.95
Examples 249	22.80	-17.12	-10.50
Examples 250	68.12	1.66	72.13
Examples 251	18.16	11.16	-24.16
Examples 252	28.16	29.16	7.63
Examples 253	44.44	-13.64	-1.28
Examples 254	23.64	-12.03	5.77
Examples 255	36.83	2.16	-20.98

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 35 (continued)

Examples	Properties of coating film	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Examples 244	2.44	-
Examples 245	1.41	0.0720
Examples 246	1.58	0.0702
Examples 247	2.42	0.0695
Examples 248	2.60	0.0688
Examples 249	1.73	0.0636
Examples 250	1.69	-
Examples 251	1.26	0.0701
Examples 252	2.25	-
Examples 253	1.40	0.0726
Examples 254	1.88	0.0697
Examples 255	2.01	0.0734

Table 36

Examples	Production of resin composition	Properties of resin composition
	Kind of composite particles	Dispersing condition (-)
Examples 256	Examples 12	5
Examples 257	Examples 13	4
Examples 258	Examples 14	5
Examples 259	Examples 15	5
Examples 260	Examples 16	5
Examples 261	Examples 17	5
Examples 262	Examples 18	5
Examples 263	Examples 19	5
Examples 264	Examples 20	5
Examples 265	Examples 21	4
Examples 266	Examples 22	4
Examples 267	Examples 23	5
Examples 268	Examples 24	5
Examples 269	Examples 25	5
Examples 270	Examples 26	5
Examples 271	Examples 27	4

Table 36 (continued)

Examples	Properties of resin composition		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Examples 256	55.66	45.26	-0.86
Examples 257	53.87	33.16	23.16
Examples 258	65.32	-4.68	-25.01
Examples 259	8.52	6.43	-15.26
Examples 260	53.32	45.16	20.30
Examples 261	76.31	4.62	73.16
Examples 262	80.11	0.87	82.63
Examples 263	47.32	50.69	4.65
Examples 264	34.96	-16.14	-2.68
Examples 265	31.62	-6.31	-26.63
Examples 266	12.00	5.42	-15.28
Examples 267	53.98	35.62	2.58
Examples 268	17.13	-16.54	-7.73
Examples 269	83.21	0.46	84.34
Examples 270	9.94	4.18	-6.83
Examples 271	16.12	-17.16	-8.98

(Note) 1): Measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.)

Table 36 (continued)

Examples	Properties of resin composition		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Examples 256	56.47	45.26	-4.56
Examples 257	55.11	33.16	17.89
Examples 258	65.63	-4.68	-27.32
Examples 259	19.11	6.43	-18.64
Examples 260	54.62	45.16	15.17
Examples 261	76.62	4.62	65.42
Examples 262	80.75	0.87	74.11
Examples 263	49.00	50.69	0.63
Examples 264	39.14	-16.14	-6.68
Examples 265	36.09	-6.31	-28.85
Examples 266	21.62	5.42	-18.66
Examples 267	55.21	35.62	-1.68
Examples 268	25.49	-16.54	-11.48
Examples 269	84.08	0.46	75.72
Examples 270	20.13	4.18	-10.62
Examples 271	24.79	-17.16	-12.67

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-is-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 36 (continued)

Examples	Properties of resin composition	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Examples 256	2.83	-
Examples 257	2.38	0.0804
Examples 258	2.54	-
Examples 259	1.36	0.0848
Examples 260	1.55	0.0813
Examples 261	2.38	0.0786
Examples 262	3.25	0.0766
Examples 263	1.66	-
Examples 264	2.26	0.0814
Examples 265	1.43	-
Examples 266	1.34	0.0858
Examples 267	1.56	0.0764
Examples 268	2.24	0.0748
Examples 269	2.34	0.0813
Examples 270	2.56	-
Examples 271	2.22	0.0867

Table 37

Examples	Production of resin composition	Properties of resin composition
	Kind of composite particles	Dispersing condition (-)
Examples 272	Examples 28	5
Examples 273	Examples 29	5
Examples 274	Examples 30	5
Examples 275	Examples 31	5
Examples 276	Examples 32	5
Examples 277	Examples 33	5
Examples 278	Examples 34	5
Examples 279	Examples 35	5
Examples 280	Examples 36	5
Examples 281	Examples 37	5
Examples 282	Examples 38	5
Examples 283	Examples 39	5
Examples 284	Examples 40	5
Examples 285	Examples 41	5

Table 37 (continued)

Examples	Properties of resin composition		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Examples 272	7.83	8.93	-19.52
Examples 273	66.64	0.11	76.01
Examples 274	25.86	43.11	20.38
Examples 275	6.79	8.64	-18.08
Examples 276	29.94	50.16	23.94
Examples 277	65.31	0.52	74.97
Examples 278	9.55	5.24	-19.56
Examples 279	26.26	46.32	19.84
Examples 280	13.14	-14.11	-6.43
Examples 281	59.93	1.16	71.92
Examples 282	4.33	8.32	-20.00
Examples 283	68.04	0.82	77.09
Examples 284	26.06	54.00	22.36
Examples 285	66.62	-1.03	72.93

(Note) 1): Measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.)

Table 37 (continued)

Examples	Properties of resin composition		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Examples 272	18.62	8.93	-22.69
Examples 273	66.96	0.11	68.13
Examples 274	31.98	43.11	15.24
Examples 275	17.88	8.64	-21.32
Examples 276	35.15	50.16	18.63
Examples 277	65.68	0.52	67.14
Examples 278	19.85	5.24	-22.72
Examples 279	32.29	46.32	14.73
Examples 280	22.79	-14.11	-9.81
Examples 281	60.61	1.16	64.24
Examples 282	16.14	8.32	-23.14
Examples 283	68.32	0.82	69.16
Examples 284	32.13	54.00	17.13
Examples 285	66.94	-1.03	65.20

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 37 (continued)

Examples	Properties of resin composition	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Examples 272	2.66	-
Examples 273	2.43	0.00833
Examples 274	2.62	-
Examples 275	1.42	0.0856
Examples 276	1.56	0.0836
Examples 277	2.43	0.0779
Examples 278	2.43	0.0816
Examples 279	1.86	-
Examples 280	1.86	0.0761
Examples 281	1.63	-
Examples 282	1.23	0.0838
Examples 283	1.64	0.0795
Examples 284	1.86	0.0812
Examples 285	1.32	0.0888

Table 38

Examples	Production of resin composition	Properties of resin composition
	Kind of composite particles	Dispersing condition (-)
Examples 286	Examples 42	5
Examples 287	Examples 43	4
Examples 288	Examples 44	5
Examples 289	Examples 45	5
Examples 290	Examples 46	5
Examples 291	Examples 47	4
Examples 292	Examples 48	5
Examples 293	Examples 49	5
Examples 294	Examples 50	5
Examples 295	Examples 51	5
Examples 296	Examples 52	5
Examples 297	Examples 53	5
Examples 298	Examples 54	5
Examples 299	Examples 55	5

Table 38 (continued)

Examples	Properties of resin composition		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Examples 286	19.61	25.62	6.63
Examples 287	15.43	-12.14	11.00
Examples 288	39.63	20.66	46.37
Examples 289	37.68	-12.51	2.89
Examples 290	9.95	36.11	5.01
Examples 291	12.71	-10.65	8.88
Examples 292	28.20	2.16	-12.70
Examples 293	11.36	21.21	9.74
Examples 294	12.82	-11.68	16.06
Examples 295	19.95	30.66	41.35
Examples 296	-0.12	-15.16	0.85
Examples 297	37.34	25.16	38.34
Examples 298	10.63	26.13	3.12
Examples 299	28.20	1.68	-12.67

(Note) 1): Measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.)

Table 38 (continued)

Examples	Properties of resin composition		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Examples 286	27.23	25.62	2.17
Examples 287	24.13	-12.14	6.33
Examples 288	42.93	20.66	39.95
Examples 289	41.34	-12.51	-1.38
Examples 290	20.14	36.11	0.63
Examples 291	22.14	-10.65	4.31
Examples 292	33.79	2.16	-16.20
Examples 293	21.16	21.21	5.13
Examples 294	22.22	-11.68	11.14
Examples 295	27.49	30.66	35.18
Examples 296	13.03	-15.16	-3.32
Examples 297	41.06	25.16	32.32
Examples 298	20.63	26.13	-1.16
Examples 299	33.79	1.68	-16.17

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 38 (continued)

Examples	Properties of resin composition	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Examples 286	2.58	-
Examples 287	1.84	0.0841
Examples 288	2.61	-
Examples 289	1.48	0.0832
Examples 290	1.65	0.0783
Examples 291	2.03	0.0826
Examples 292	2.16	0.0832
Examples 293	1.12	-
Examples 294	1.81	0.0788
Examples 295	1.44	-
Examples 296	1.22	0.0817
Examples 297	1.48	0.0775
Examples 298	1.80	0.0829
Examples 299	1.62	0.0883

Table 39

Comparative Examples	Production of resin composition	Properties of resin composition
	Kind of organic pigments or composite particles	Dispersing condition (-)
Comparative Examples 65	Organic pigment B-1	2
Comparative Examples 66	Organic pigment B-2	1
Comparative Examples 67	Organic pigment G-1	2
Comparative Examples 68	Organic pigment R-1	2
Comparative Examples 69	Organic pigment R-2	2
Comparative Examples 70	Organic pigment R-3	1
Comparative Examples 71	Organic pigment Y-1	1
Comparative Examples 72	Organic pigment Y-2	1
Comparative Examples 73	Comparative Examples 1	2
Comparative Examples 74	Comparative Examples 2	3
Comparative Examples 75	Comparative Examples 3	2
Comparative Examples 76	Comparative Examples 4	3
Comparative Examples 77	Comparative Examples 5	2

Table 39 (continued)

Comparative Examples	Properties of resin composition		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Comparative Examples 65	6.81	7.63	-17.38
Comparative Examples 66	3.17	9.34	-21.02
Comparative Examples 67	13.13	-16.14	-6.54
Comparative Examples 68	32.42	49.16	23.68
Comparative Examples 69	20.80	56.32	22.39
Comparative Examples 70	31.18	46.12	21.62
Comparative Examples 71	63.69	0.66	74.11
Comparative Examples 72	66.34	0.32	76.04
Comparative Examples 73	57.88	-2.10	-24.96
Comparative Examples 74	88.63	0.31	2.01
Comparative Examples 75	55.56	-1.80	-25.83
Comparative Examples 76	73.32	-0.78	-3.01
Comparative Examples 77	5.74	6.42	15.78

(Note) 1): Measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.)

Table 39 (continued)

Comparative Examples	Properties of resin composition		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Comparative Examples 65	17.89	7.63	-20.65
Comparative Examples 66	15.32	9.34	-24.11
Comparative Examples 67	22.78	-16.14	-9.92
Comparative Examples 68	37.11	49.16	18.38
Comparative Examples 69	28.13	56.32	17.16
Comparative Examples 70	36.13	46.12	16.42
Comparative Examples 71	64.13	0.66	66.32
Comparative Examples 72	66.67	0.32	68.16
Comparative Examples 73	58.52	-2.10	-27.27
Comparative Examples 74	90.05	0.31	-1.86
Comparative Examples 75	56.37	-1.80	-28.09
Comparative Examples 76	73.64	-0.78	-6.59
Comparative Examples 77	17.13	6.42	-19.13

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 39 (continued)

Comparative Examples	Properties of resin composition	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Comparative Examples 65	11.24	0.2227
Comparative Examples 66	11.15	0.2321
Comparative Examples 67	9.42	0.2124
Comparative Examples 68	15.68	0.3263
Comparative Examples 69	17.23	0.2162
Comparative Examples 70	19.26	0.2963
Comparative Examples 71	17.78	0.2816
Comparative Examples 72	20.01	0.2614
Comparative Examples 73	7.68	-
Comparative Examples 74	7.00	-
Comparative Examples 75	7.22	-
Comparative Examples 76	7.18	-
Comparative Examples 77	10.98	-

Table 40

Comparative Examples	Production of resin composition	Properties of resin composition
	Kind of composite particles	Dispersing condition (-)
Comparative Examples 78	Comparative Examples 6	2
Comparative Examples 79	Comparative Examples 7	3
Comparative Examples 80	Comparative Examples 8	2
Comparative Examples 81	Comparative Examples 9	2
Comparative Examples 82	Comparative Examples 10	2
Comparative Examples 83	Comparative Examples 11	2
Comparative Examples 84	Comparative Examples 12	3
Comparative Examples 85	Comparative Examples 13	2
Comparative Examples 86	Comparative Examples 14	2
Comparative Examples 87	Comparative Examples 15	3
Comparative Examples 88	Comparative Examples 16	2

Table 40 (continued)

Comparative Examples	Properties of resin composition		
	Hue		
	L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Comparative Examples 78	58.10	0.08	75.42
Comparative Examples 79	59.44	0.19	72.96
Comparative Examples 80	88.69	1.01	4.19
Comparative Examples 81	63.05	3.32	-20.11
Comparative Examples 82	56.33	1.68	-17.10
Comparative Examples 83	60.53	0.09	-14.79
Comparative Examples 84	58.66	0.29	-15.67
Comparative Examples 85	59.97	-0.88	-13.80
Comparative Examples 86	28.20	12.11	-8.85
Comparative Examples 87	25.00	16.23	-6.08
Comparative Examples 88	66.40	-1.32	58.14

(Note) 1): Measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.)

Table 40 (continued)

Comparative Examples	Properties of resin composition		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Comparative Examples 78	58.93	0.08	67.57
Comparative Examples 79	60.16	0.19	65.23
Comparative Examples 80	90.31	1.01	-0.15
Comparative Examples 81	63.53	3.32	-23.25
Comparative Examples 82	57.32	1.68	-20.39
Comparative Examples 83	61.17	0.09	-18.19
Comparative Examples 84	59.44	0.29	-19.03
Comparative Examples 85	60.65	-0.88	-17.25
Comparative Examples 86	33.79	12.11	-12.54
Comparative Examples 87	31.32	16.23	-9.91
Comparative Examples 88	66.73	-1.32	51.14

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 40 (continued)

Comparative Examples	Properties of resin composition	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Comparative Examples 78	7.62	-
Comparative Examples 79	7.82	-
Comparative Examples 80	6.91	-
Comparative Examples 81	6.66	-
Comparative Examples 82	7.31	-
Comparative Examples 83	7.26	-
Comparative Examples 84	7.25	-
Comparative Examples 85	7.88	-
Comparative Examples 86	6.96	-
Comparative Examples 87	6.83	-
Comparative Examples 88	7.19	-

Table 41

Examples	Production of master batch pellet	
	Composite particles	
	Kind	Amount blended (wt. part)
Examples 300	Examples 12	20.0
Examples 301	Examples 15	20.0
Examples 302	Examples 16	20.0
Examples 303	Examples 17	20.0
Examples 304	Examples 18	20.0
Examples 305	Examples 20	20.0
Examples 306	Examples 21	20.0
Examples 307	Examples 22	20.0
Examples 308	Examples 12	20.0
Examples 309	Examples 15	20.0
Examples 310	Examples 17	20.0
Examples 311	Examples 12	30.0
Examples 312	Examples 15	30.0
Examples 313	Examples 12	30.0

Table 41 (continued)

Examples	Production of master batch pellet	
	Resin	
	Kind	Amount blended (wt. part)
Examples 300	Polyvinyl chloride resin	80.0
Examples 301	Polyvinyl chloride resin	80.0
Examples 302	Polyvinyl chloride resin	80.0
Examples 303	Polyvinyl chloride resin	80.0
Examples 304	Polyvinyl chloride resin	80.0
Examples 305	Polyvinyl chloride resin	80.0
Examples 306	Polyvinyl chloride resin	80.0
Examples 307	Polyvinyl chloride resin	80.0
Examples 308	Styrene-acrylic copolymer resin	80.0
Examples 309	Styrene-acrylic copolymer resin	80.0
Examples 310	Styrene-acrylic copolymer resin	80.0
Examples 311	Low-density polyethylene	70.0
Examples 312	Polypropylene	70.0
Examples 313	High-density polyethylene	70.0

Table 41 (continued)

Examples	Master batch pellet		
	Shape	Average major diameter (average length) (mm)	Average minor diameter (average diameter) (mm)
Examples 300	Cylindrical	4.3	3.2
Examples 301	Cylindrical	3.8	3.1
Examples 302	Cylindrical	4.1	3.0
Examples 303	Cylindrical	4.3	2.9
Examples 304	Cylindrical	4.2	3.1
Examples 305	Cylindrical	3.9	3.2
Examples 306	Cylindrical	3.2	3.3
Examples 307	Cylindrical	3.8	3.2
Examples 308	Cylindrical	3.9	3.3
Examples 309	Cylindrical	4.1	3.2
Examples 310	Cylindrical	4.3	3.2
Examples 311	Cylindrical	4.2	3.0
Examples 312	Cylindrical	4.3	3.1
Examples 313	Cylindrical	4.0	3.0

Table 42

Examples	Production of master batch pellet	
	Composite particles	
	Kind	Amount blended (wt. part)
Examples 314	Examples 28	20.0
Examples 315	Examples 31	20.0
Examples 316	Examples 32	20.0
Examples 317	Examples 33	20.0
Examples 318	Examples 34	20.0
Examples 319	Examples 36	20.0
Examples 320	Examples 37	20.0
Examples 321	Examples 38	20.0
Examples 322	Examples 42	20.0
Examples 323	Examples 45	20.0
Examples 324	Examples 47	20.0
Examples 325	Examples 48	20.0
Examples 326	Examples 28	20.0
Examples 327	Examples 31	20.0
Examples 328	Examples 33	20.0
Examples 329	Examples 28	30.0
Examples 330	Examples 31	30.0
Examples 331	Examples 28	30.0

Table 42 (continued)

Examples	Production of master batch pellet	
	Resin	
	Kind	Amount blended (wt. part)
Examples 314	Polyvinyl chloride resin	80.0
Examples 315	Polyvinyl chloride resin	80.0
Examples 316	Polyvinyl chloride resin	80.0
Examples 317	Polyvinyl chloride resin	80.0
Examples 318	Polyvinyl chloride resin	80.0
Examples 319	Polyvinyl chloride resin	80.0
Examples 320	Polyvinyl chloride resin	80.0
Examples 321	Polyvinyl chloride resin	80.0
Examples 322	Polyvinyl chloride resin	80.0
Examples 323	Polyvinyl chloride resin	80.0
Examples 324	Polyvinyl chloride resin	80.0
Examples 325	Polyvinyl chloride resin	80.0
Examples 326	Styrene-acrylic copolymer resin	80.0
Examples 327	Styrene-acrylic copolymer resin	80.0
Examples 328	Styrene-acrylic copolymer resin	80.0
Examples 329	Low-density polyethylene	70.0
Examples 330	Polypropylene	70.0
Examples 331	High-density polyethylene	70.0

Table 42 (continued)

Examples	Master batch pellet		
	Shape	Average major diameter (average length) (mm)	Average minor diameter (average diameter) (mm)
Examples 314	Cylindrical	4.1	3.1
Examples 315	Cylindrical	4.0	3.0
Examples 316	Cylindrical	4.3	2.9
Examples 317	Cylindrical	4.1	3.0
Examples 318	Cylindrical	3.8	3.1
Examples 319	Cylindrical	4.0	3.0
Examples 320	Cylindrical	3.9	3.2
Examples 321	Cylindrical	4.1	3.1
Examples 322	Cylindrical	4.2	3.2
Examples 323	Cylindrical	3.9	3.1
Examples 324	Cylindrical	4.0	3.0
Examples 325	Cylindrical	4.1	2.9
Examples 326	Cylindrical	4.0	3.3
Examples 327	Cylindrical	3.8	3.2
Examples 328	Cylindrical	3.7	3.2
Examples 329	Cylindrical	4.0	3.3
Examples 330	Cylindrical	4.1	3.0
Examples 331	Cylindrical	4.2	3.1

Table 43

Examples	Production of resin composition	
	Master batch pellet	
	Kind	Amount blended (wt. part)
Examples 332	Examples 300	25.0
Examples 333	Examples 301	25.0
Examples 334	Examples 302	25.0
Examples 335	Examples 303	25.0
Examples 336	Examples 304	25.0
Examples 337	Examples 305	25.0
Examples 338	Examples 306	25.0
Examples 339	Examples 307	25.0
Examples 340	Examples 314	25.0
Examples 341	Examples 315	25.0
Examples 342	Examples 316	25.0
Examples 343	Examples 317	25.0
Examples 344	Examples 318	25.0
Examples 345	Examples 319	25.0
Examples 346	Examples 320	25.0
Examples 347	Examples 321	25.0
Examples 348	Examples 322	25.0
Examples 349	Examples 323	25.0
Examples 350	Examples 324	25.0
Examples 351	Examples 325	25.0

Table 43 (continued)

Examples	Production of resin composition	
	Resin	
	Kind	Amount blended (wt. part)
Examples 332	Polyvinyl chloride resin	74.5
Examples 333	Polyvinyl chloride resin	74.5
Examples 334	Polyvinyl chloride resin	74.5
Examples 335	Polyvinyl chloride resin	74.5
Examples 336	Polyvinyl chloride resin	74.5
Examples 337	Polyvinyl chloride resin	74.5
Examples 338	Polyvinyl chloride resin	74.5
Examples 339	Polyvinyl chloride resin	74.5
Examples 340	Polyvinyl chloride resin	74.5
Examples 341	Polyvinyl chloride resin	74.5
Examples 342	Polyvinyl chloride resin	74.5
Examples 343	Polyvinyl chloride resin	74.5
Examples 344	Polyvinyl chloride resin	74.5
Examples 345	Polyvinyl chloride resin	74.5
Examples 346	Polyvinyl chloride resin	74.5
Examples 347	Polyvinyl chloride resin	74.5
Examples 348	Polyvinyl chloride resin	74.5
Examples 349	Polyvinyl chloride resin	74.5
Examples 350	Polyvinyl chloride resin	74.5
Examples 351	Polyvinyl chloride resin	74.5

Table 43 (continued)

Examples	Production of resin composition	
	Additive	
	Kind	Amount blended (wt. part)
Examples 332	Calcium stearate	0.5
Examples 333	Calcium stearate	0.5
Examples 334	Calcium stearate	0.5
Examples 335	Calcium stearate	0.5
Examples 336	Calcium stearate	0.5
Examples 337	Calcium stearate	0.5
Examples 338	Calcium stearate	0.5
Examples 339	Calcium stearate	0.5
Examples 340	Calcium stearate	0.5
Examples 341	Calcium stearate	0.5
Examples 342	Calcium stearate	0.5
Examples 343	Calcium stearate	0.5
Examples 344	Calcium stearate	0.5
Examples 345	Calcium stearate	0.5
Examples 346	Calcium stearate	0.5
Examples 347	Calcium stearate	0.5
Examples 348	Calcium stearate	0.5
Examples 349	Calcium stearate	0.5
Examples 350	Calcium stearate	0.5
Examples 351	Calcium stearate	0.5

Table 44

Examples	Properties of resin composition			
	Dispersing condition (-)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Examples 332	5	55.01	45.18	-0.03
Examples 333	5	11.50	6.83	-16.29
Examples 334	5	56.11	38.64	21.40
Examples 335	5	79.59	1.62	77.06
Examples 336	5	81.31	1.21	83.38
Examples 337	5	33.54	-7.63	-4.23
Examples 338	5	32.32	-5.16	-28.24
Examples 339	5	11.27	7.96	-16.33

(Note) 1): Measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.)

Table 44 (continued)

Examples	Properties of resin composition		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Examples 332	56.13	46.18	-4.16
Examples 333	21.26	6.83	-19.62
Examples 334	57.12	46.64	16.21
Examples 335	80.13	3.62	69.13
Examples 336	81.99	1.21	75.14
Examples 337	38.00	-17.63	-8.15
Examples 338	37.03	-7.16	-30.98
Examples 339	21.09	7.96	-19.65

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 44 (continued)

Examples	Properties of resin composition	
	Light resistance (ΔE^* value) (-)	Transparency (linear absorption) (μm^{-1})
Examples 332	2.78	-
Examples 333	1.27	0.0761
Examples 334	1.48	0.0722
Examples 335	2.26	0.0698
Examples 336	3.03	0.0675
Examples 337	2.11	0.0703
Examples 338	1.36	-
Examples 339	1.26	0.0766

Table 45

Examples	Properties of resin composition			
	Dispersing condition (-)	Hue		
		L* value ¹⁾ (-)	a* value ¹⁾ (-)	b* value ¹⁾ (-)
Examples 340	5	9.94	8.12	-20.02
Examples 341	5	7.80	9.13	-19.81
Examples 342	5	30.54	52.14	24.72
Examples 343	5	69.87	0.56	77.23
Examples 344	5	11.91	5.77	-18.86
Examples 345	5	12.26	-15.13	-4.63
Examples 346	5	63.67	1.82	76.01
Examples 347	5	6.64	9.63	-21.15
Examples 348	5	20.80	28.16	9.21
Examples 349	5	41.08	-13.13	2.65
Examples 350	5	12.74	-11.65	10.06
Examples 351	5	29.51	2.63	-13.83

(Note) 1): Measured by a portable spectrophotometer "COLOR-GUIDE 45/0" (manufactured by BYK CHEMIE JAPAN CO., LTD.)

Table 45 (continued)

Examples	Properties of resin composition		
	Hue		
	L* value ²⁾ (-)	a* value ²⁾ (-)	b* value ²⁾ (-)
Examples 340	20.13	8.12	-23.16
Examples 341	18.60	9.13	-22.96
Examples 342	35.62	52.14	19.37
Examples 343	70.12	0.56	69.29
Examples 344	21.56	5.77	-22.06
Examples 345	22.20	-15.13	-8.53
Examples 346	64.11	1.82	68.13
Examples 347	17.77	9.63	-24.24
Examples 348	28.13	28.16	4.63
Examples 349	44.13	-13.13	-1.61
Examples 350	22.16	-11.65	5.43
Examples 351	34.81	2.63	-17.28

(Note) 2): Measured by a multi-spectro-colour-meter "MSC-IS-2D" (manufactured by SUGA TESTING MACHINES MANUFACTURING CO., LTD.)

Table 45 (continued)

Examples	Properties of resin composition	
	Light resistance..	Transparency
	(ΔE^* value) (-)	(linear absorption). (μm^{-1})
Examples 340	2.53	-
Examples 341	1.36	0.0766
Examples 342	1.46	0.0747
Examples 343	2.35	0.0685
Examples 344	2.38	0.0731
Examples 345	1.69	0.0673
Examples 346	1.60	-
Examples 347	1.13	0.0754
Examples 348	2.50	-
Examples 349	1.44	0.0746
Examples 350	1.97	0.0738
Examples 351	1.93	0.0744

Claims

1. Composite particles which have an average particle diameter of from 0.001 to 10.0 μm , comprising:
 - (i) white inorganic particles as core particles;
 - (ii) a gluing agent coating layer provided on the surface of said white inorganic particles; and
 - (iii) an organic pigment coat provided on said gluing agent coating layer in an amount of from 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.
2. Composite particles which have an average particle diameter of from 0.001 to 10.0 μm , comprising:
 - (i) white inorganic particles as core particles;
 - (ii) a gluing agent coating layer provided on the surface of said white inorganic particles; and
 - (iii) at least two colored adhesion layers comprising an organic pigment, provided on said coating layer through a gluing agent, the amount of the organic pigment being 1 to 500 parts by weight based on 100 parts by weight of said white inorganic particles.
3. Particles according to claim 1 or 2, wherein said gluing agent comprises an organosilicon compound, a coupling agent, an oligomer compound or a polymer compound.
4. Particles according to claim 3, wherein said organosilicon compound is an organosilane compound obtainable from alkoxysilane compounds, a polysiloxane or modified polysiloxane, or a fluoroalkyl organosilane compound obtainable from fluoroalkylsilane compounds.
5. Particles according to claim 3 or 4, wherein said coupling agent is a silane-based coupling agent, a titanate-based coupling agent, an aluminate-based coupling agent or a zirconate-based coupling agent.
6. Composite particles which have an average particle diameter of from 0.001 to 10.0 μm , comprising:
 - (i) white inorganic particles as core particles;
 - (ii) a coating layer provided on the surface of said white inorganic particles, comprising at least one organosilicon compound selected from:
 - (1) organosilane compounds obtainable from alkoxysilane compounds, and
 - (2) polysiloxanes or modified polysiloxanes; and
 - (iii) an organic pigment coat provided on the coating layer in an amount of from 1 to 100 parts by weight based on 100 parts by weight of said white inorganic particles.
7. Particles according to any one of the preceding claims, wherein said white inorganic particles comprise a white pigment, a pearl pigment or an extender pigment.
8. Composite particles which have an average particle diameter of from 0.001 to 0.5 μm , comprising:
 - (i) extender pigment particles as core particles;
 - (ii) a gluing agent coating layer provided on the surface of said extender pigment particles, comprising an organosilicon compound, a coupling agent, an oligomer compound or a polymer compound; and
 - (iii) an organic pigment coat provided on the gluing agent coating layer in an amount of from 1 to 500 parts by weight based on 100 parts by weight of said extender pigment particles.
9. Particles according to claim 8, which have an average particle diameter of from 0.001 to 0.3 μm .
10. Particles according to any one of the preceding claims, wherein said core particles have a coating layer comprising at least one compound selected from hydroxides of aluminum, oxides of aluminum, hydroxides of silicon and oxides of silicon, provided on at least part of their surface.
11. Particles according to any one of the preceding claims, wherein said organic pigment is an organic red-based pigment, an organic blue-based pigment, an organic yellow-based pigment or an organic green-based pigment.

12. Particles according to any one of the preceding claims, which have a BET specific surface area value of from 1.0 to 500 m²/g.
13. Particles according to any one of the preceding claims, which have a tinting strength of not less than 110%, and a light resistance (ΔE^* value) of not more than 5.0.
14. Composite particles according to claim 13, wherein said composite particles have a tinting strength of not less than 115%.
15. Particles according to any one of the preceding claims, wherein the amount of said organic pigment coat provided on said gluing agent coating layer is from 1 to 300 parts by weight based on 100 parts by weight of said core particles.
16. Particles according to any one of the preceding claims, wherein the amount of the gluing agent coating layer comprising an organosilicon compound or a silane-based coupling agent is from 0.02 to 5.0% by weight, calculated as Si, based on the weight of the gluing agent-coated core particles, and the amount of the gluing agent coating layer comprising a titanate-based coupling agent, an aluminate-based coupling agent, a zirconate-based coupling agent, an oligomer or a polymer compound is from 0.01 to 15.0% by weight, calculated as C, based on the weight of the gluing agent-coated core particles.
17. A process for producing composite particles as defined in claim 1, comprising:
 - (a) mixing white inorganic particles with a gluing agent under stirring to form a gluing agent coating layer on the surface of said white inorganic particles; and
 - (b) mixing an organic pigment with the gluing agent-coated white inorganic particles under stirring to form an organic pigment coat on the gluing agent coating layer.
18. A pigment comprising composite particles as defined in any one of claims 1 to 16.
19. A paint comprising a pigment as defined in claim 18 and a paint base material.
20. A paint according to claim 19, wherein the amount of said pigment is from 0.5 to 100 parts by weight based on 100 parts by weight of said paint base material.
21. A rubber or resin composition comprising a pigment as defined in claim 18 and a base material for rubber or resin composition.
22. A composition according to claim 21, wherein the amount of said pigment is from 0.05 to 200 parts by weight based on 100 parts by weight of said base material for rubber or resin composition.
23. A pigment dispersion for solvent-based paint comprising:
 - 100 parts by weight of a pigment dispersion base material for solvent-based paint; and
 - from 5 to 1,000 parts by weight of a pigment as defined in claim 18.
24. A pigment dispersion for water-based paint comprising:
 - 100 parts by weight of a pigment dispersion base material for water-based paint; and
 - from 5 to 1,000 parts by weight of a pigment as defined in claim 18.
25. Master batch pellets comprising:
 - 100 parts by weight of rubber or thermoplastic resins; and
 - from 1 to 100 parts by weight of a pigment as defined in claim 18.

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